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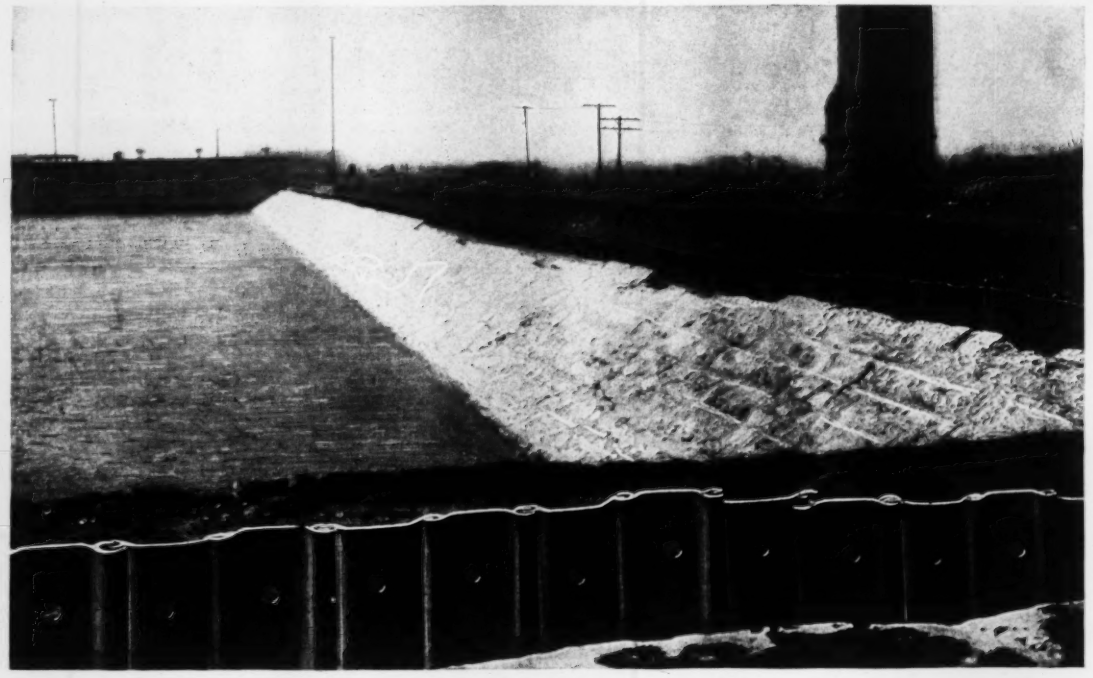

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Engineering News

VOLUME 77 FEBRUARY 1, 1917 NUMBER 5

Concrete-Mixer Boat for Ohio River Locks

By A. W. Kreamer* and Gregory M. Dexter†

In connection with the improvement of the Ohio River with locks and dams by the United States Government, the Wheeling district of the United States Engineer Department is building some of the work with hired labor. This fact necessitated the design of a plant for the mixing and handling of concrete and the concrete-mixer boat described in this article resulted.

Fig. 2 shows a typical layout of a lock and dam in the Wheeling district. The concrete yardage involved will vary from 50,000 to 100,000. This amount in conjunction with the T shape of the lock and dam, the necessity of maintaining navigation and an available net working period each year of from five to seven months has resulted in the experience that three to four years are needed to complete the masonry, although in some cases two have been sufficient.

The following methods have been used for mixing and handling concrete on the Ohio River work in the Wheeling district:

1. Mixing Plant Upon the Shore—With cableway.

2. Mixing Plants Upon or Just Inside the Coffer-dams—(a) With narrow-gage tracks leading to derricks that deposit the concrete in the forms; (b) with narrow-gage tracks upon the top of the forms, permitting the dumping of the concrete directly into place; (c) with platforms along which buggies are pushed by laborers to the forms and dumped; (d) with chutes from mixer to forms (where the forms were too high or too distant to be reached easily with the chute, there was a hoist tower at the mixer).

3. Mixing Plant Upon a Boat—(a) With hoist tower and chutes supported by cables; (b) with hoist tower and boom so that cables were not necessary to support chutes.

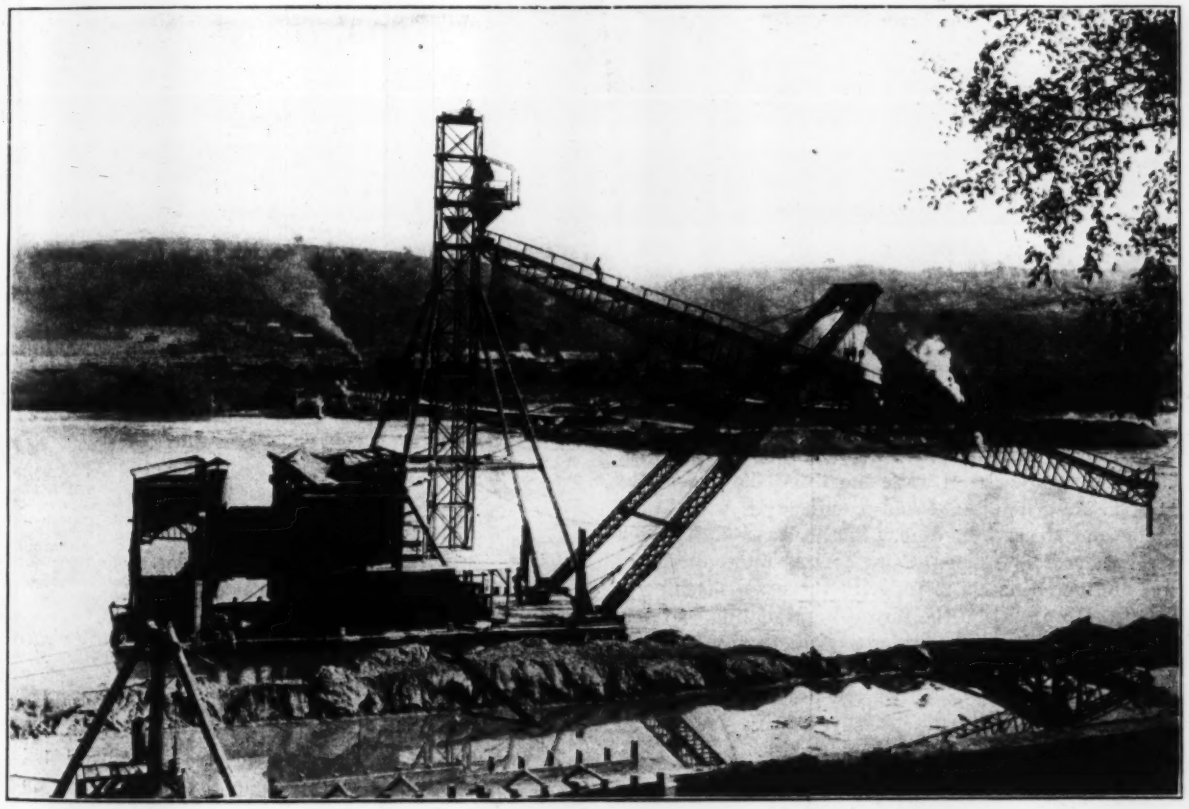

FIG. 1. VIEW OF CONCRETE-MIXER BOAT ALONGSIDE COFFER-DAM ON OHIO RIVER LOCK

Boom shown 163 ft. can be lengthened to 200 ft. A-frame 84 ft. high can be raised to 98 ft. Hoist tower 95 ft., maximum 105 ft. Note stiff-legs to hoist tower and that side of gravel bin has not been closed up

The decision to build a concrete-mixer boat with hoist tower and boom was based upon certain arguments among

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†Formerly Junior Engineer, United States Engineer Office, Wheeling, W. Va., now with the Honolulu Iron Works Co., New York City.

which may be mentioned the following: Concrete materials can be placed aboard a mixer boat as economically as in a mixing plant on a coffer-dam. The latter has to be dismantled and rebuilt for each coffer-dam, while with a mixer boat more elaborate construction is justifiable. The additional investment necessary to provide for boom and supporting A-frame as well as a conveyor system for handling cement bags is small after the mixer boat has been designed to carry bins, machinery and hoist tower. Much miscellaneous equipment is eliminated from the coffer-dam by the mixer boat, which gives more space or permits a smaller coffer-dam and helps when pumping out after high water. During the season of 1915 a rental of $35 per day was paid for a mixer boat, but without boom and

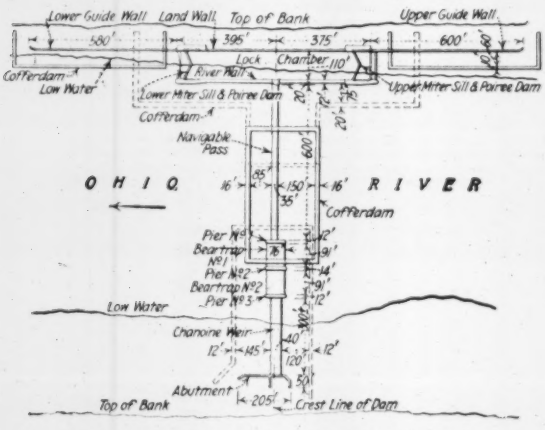


FIG. 2. TYPICAL LOCK AND DAM ON OHIO RIVER

A-frame. For the Government work a mixer boat would be used on the construction of more than one dam. Finally, the behavior of a similar but smaller boat, which had been built by the T. A. Gillespie Co., had shown its advantages.

It was not possible to delay the design and building of the mixer-boat hull until the loads it would have to carry had been determined. It was known that the mixer boat of the T. A. Gillespie Co. had a hull 32 ft. wide by 80 ft. long and about 5 ft. deep. The loads on it included a steel boom 158 ft. long, a wooden A-frame and hoist tower and one concrete mixer with the usual machinery, bins, etc. In operation the forward end of this boat was frequently level with the water surface, indicating that there was a small margin of stability for additional loads. Accordingly, the dimensions of the proposed mixer-boat hull were rather arbitrarily placed at 40 ft. wide by 90 ft. long and 6 ft. 9 in. deep at the gunwales.

Conditions Controlling Design

Later, the design of the bins, boom, etc., was undertaken. A congested steel market, the low cost of the mixer boat and pressure of other work left little opportunity for comparative designs. Some rather arbitrary assumptions were made, and a statement of these and the limiting conditions encountered follows:

From a study of the two positions in Fig. 3 the boom was designed for a range in slope from 1 on 2½ to 1 on 4, and erection in lengths of 163 ft., 180 ft. and 200 ft., with the connection to the hoist tower at the heights shown. It was recognized that at extreme low water it might be necessary, in filling the upper portion of the land-wall form, to discharge the concrete from the boom into buckets that would be lifted and dumped by a traveling derrick. Stability considerations, the frequency of extreme low water and the yardage involved were sufficient to justify the heights adopted. The boom was designed for support near its center by cables that would be approximately vertical. The distance back to the hoist tower was tentatively placed at 25 ft., and later this was found to work in satisfactorily with the location of the bins. These considerations determined the maximum and minimum lengths of the A-frame as 98 ft. and 84 ft. respectively, as well as its angle with the horizontal.

No provisions were made for quick shifts of connections in the boom, hoist tower and A-frame, as the masonry in a large coffer-dam requires about a season to complete. The A-frame head was made 15 ft. long in order that sway cables could be run from each end to the top chords of the boom. Removable crossbracing was provided in the plane of the legs of the A-frame. The depth of the boom was rather arbitrarily placed at 10 ft. The Insley Manufacturing Co.'s roller hoist bucket of 36 cu.ft. capacity was selected, owing to its low overall height and the consequent lowering of the center of gravity of the bins. The width of the hoist tower was determined by that of the bucket. The width of the boom was made about the same as the tower, which gave a simple connection to the tower as well as made satisfactory use of 2½x2½x¼-in. angles for wind bracing in the boom. The

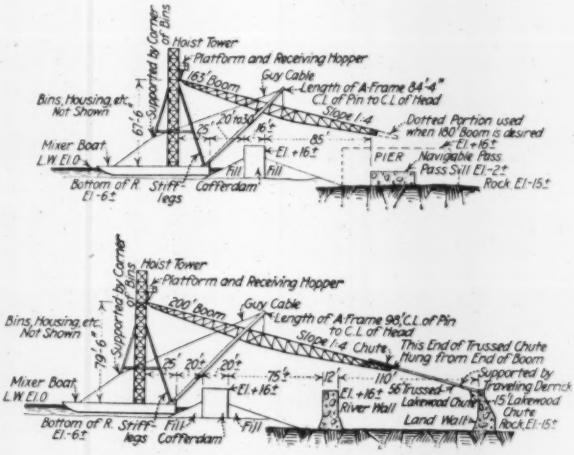


FIG. 3. OUTLINES OF MIXER WITH (ABOVE) SHORT AND WITH (BELOW) LONG DELIVERY

depth of the hoist tower was made 8 ft., and stiff-legs were provided for bracing instead of guy cables.

It was decided to make use of two right-hand 1¼-cu.yd. Smith mixers that were on hand, although one right and one left of another type would have lowered the center of gravity of the bins. Their arrangement relative to each other and the hoist tower was determined by the slope of chute to bucket and the flow of the concrete without changes in direction. It was decided to use a derrick boat with 80-ft. trussed boom, located alongside the mixer boat, for filling the bins. These decisions limited the height and location of the sand and gravel bins. For ballast purposes the coal bin and boilers were placed at the aft end of the boat.

The boom was designed for three loadings:

1. Concentrated load of 5000 lb. at the lower end and its own dead weight, using the customary unit stresses.

2. Twenty pounds per square foot of wind pressure broadside on and its own dead weight, using unit stresses 33⅓ in excess of normal.

3. Its dead weight as a beam supported near each end, using unit stresses 33⅓ in excess of normal.

The preceding embraces most of the important conditions or assumptions that controlled the design of the mixer boat. A general description of the boat as equipped and operated follows.

Details of Equipment of Plant

The following machinery was provided: Two 80-hp. boilers of the return-tubular type; one horizontal duplex service pump for general water-supply purposes, size 9x5¼x10 in.; one horizontal duplex feed-water pump, size 5½x3¾x5 in.; one 100-hp. feed-water heater; one 2-cylinder 12x12-in. two-drum hoisting engine for hoist and separate compartments for the sand and gravel, prevents any delay from the sticking or arching action of the aggregate.

Bags of cement are brought to the mixer boat on a covered scow that has a capacity of 3500, are carried from the scow by a cleated chain conveyor and elevated by a curved-arm carrier to a platform above the mixers and 6 in. below the tops of two cement hoppers, into which they are emptied. This platform provides storage for 200 bags as insurance against conveyor delays. The lever that controls the flow of the aggregate into the mixer controls the cement also. The cleated chain conveyor may be rotated about its driveshaft into the nearly vertical position.

The concrete spilled about the boat at the end of an 8-hr. run does not exceed ⅓ cu.yd., due to a tilting chute.

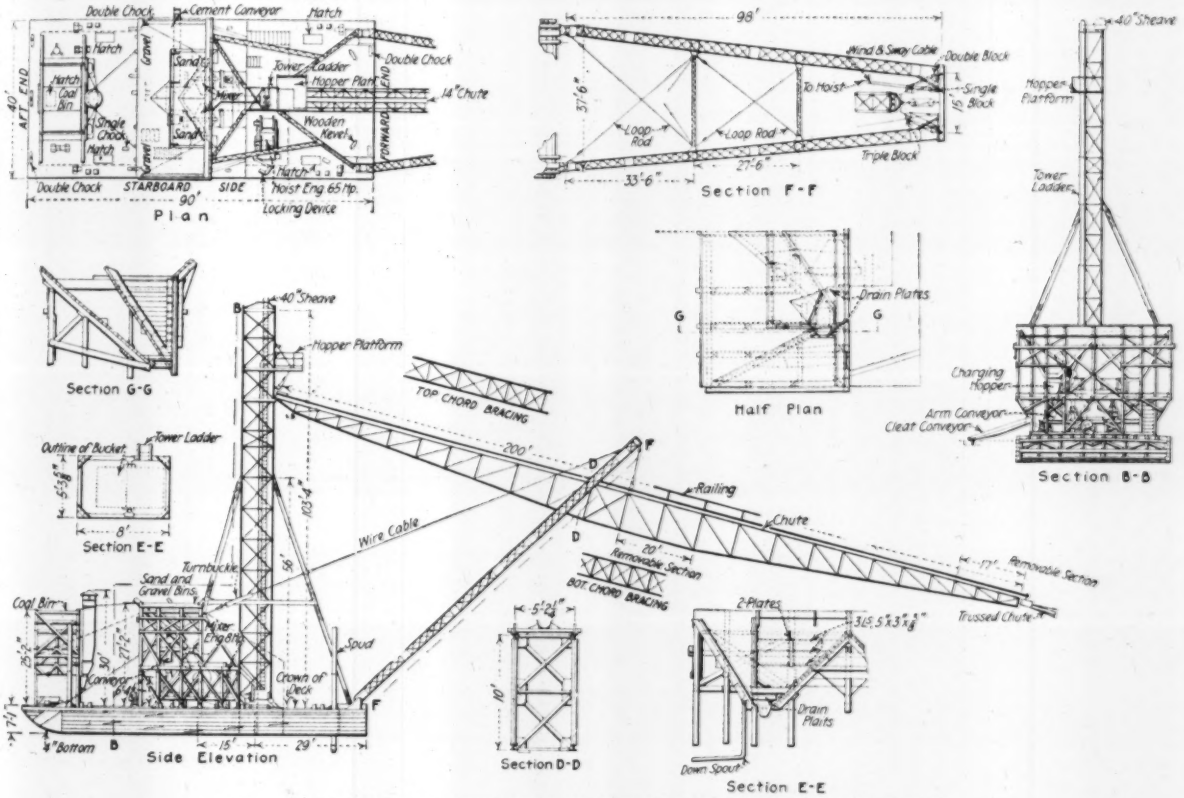


FIG. 4. DETAILS OF THE OHIO RIVER FLOATING CONCRETE PLANT

bucket and boom; one 20-hp. two-cylinder winch engine for cement conveyor and spuds; five steam siphons; two 1¼-cu.yd. mixers, each driven by a vertical 8-hp. engine; one chain conveyor with wooden cleats; and one chain conveyor with curved-arm carriers.

A water line for washing out the chute on the boom, as well as steam lines for heating the chute, concrete materials, etc., has been provided. The method of filling the bins necessitated a low smokestack, but this was offset by a steam connection for forced draft. The water for each mixer is supplied through a 2-in. Trident water meter, a quick-closing gate valve and a pump operating against a relief valve. The meter dial is graduated from 0 to 100 gal., and the pointer can be set back to zero quickly.

A special measuring hopper on each mixer, with slopes ranging from 12 on 6 to the vertical, an outlet 12x18 in. the vertical travel of the bucket, the use of 1-yd. batches in a bucket whose capacity is 36 cu.ft., and a 2½-ft. bulkhead about the top of the receiving hopper on all except the tower side. Also, the tilting chute permits greater acceleration of the hoist-bucket speed by providing vertical travel and making it unnecessary to wait until all the material from the mixers has entered the bucket. The lower end of the hoist tower is in a watertight well with a removable and easily replaced bottom that would be knocked out by a falling bucket. Just above the receiving hopper are two parallel timbers that extend horizontally through the tower from the forward to the aft side, while horizontally against the forward side is another timber. Against these the bail and sides of the bucket hit when it is dumped, and thus enable the hoisting engineer to clean the bucket of concrete without assistance. The two parallel timbers prevent, also, the

bucket from being carried too high. An automatic locking device upon the boom cable, consisting of a brake and sheave and working upon the principle of the toggle joint, takes the boom load from the hoisting engine.

The coal bin has a capacity of 60 tons, a flaring top, a sloping removable roof and is lined with No. 13 United States Standard sheet steel. Under each boiler are an ashpit and well.

As an assistance in maneuvering and holding the mixer boat it is provided with four hickory spuds 14x14 in. by 32 ft. They are operated by lines from the nigger heads on the conveyor engine, are equipped with flattened cast-iron points and bear on cast-iron rollers.

There are two sand and two gravel bins. All are lined with No. 13 United States Standard sheet steel are provided with drain plates and have side slopes ranging from the vertical to 12 on 8. Each sand bin has a capacity of 570 and each gravel bin of 1030 cu.ft. Roughly, all the bins may be described as inverted hollow

mit indicated that the margin of stability against overturning in a broadside windstorm was not as high as might be desired. However, there were not sufficient reasons to justify any revision in loading in view of the prior design and completion of the hull. Table 1 on p. 173 shows the results of the final estimates of stability.

The mixer-boat hull has 4-in. bottom planking, 3-in. decking, 8-in. gunwales, two longitudinal bulkheads and four trusses. Transversely, there are seven trusses, at four of which there are truss rods. An estimate of the maximum bending and longitudinal shearing stresses in the gunwales and bulkheads shows values ranging from 350 to 700 and from 80 to 140 lb. per sq.in. respectively for the various loadings.

The methods followed in erecting the steel on the mixer boat have no interest except as regards the A-frame and boom. The upper portion of the A-frame was erected on sloping cribwork on the river bank; the lower portion was put in place on the mixer boat and guyed at the

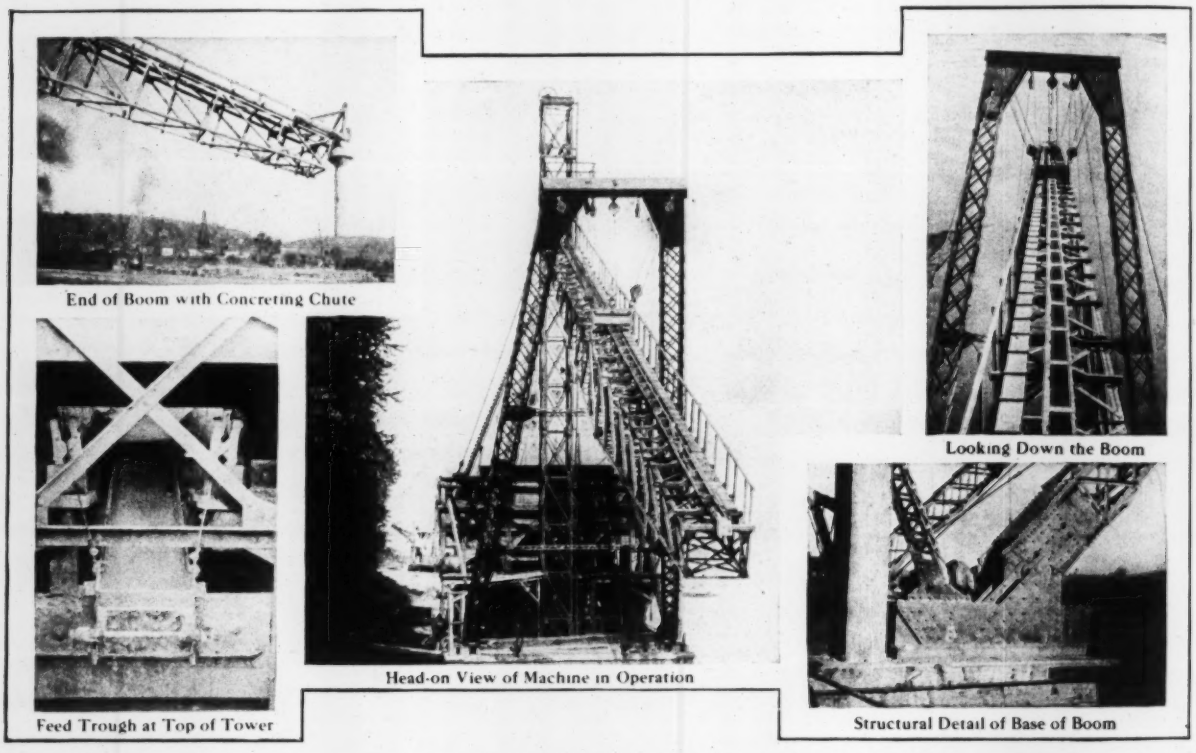

End of Boom with Concreting Chute
Looking Down the Boom
Feed Trough at Top of Tower
Head-on View of Machine in Operation
Structural Detail of Base of Boom

FIG. 5. DETAIL VIEWS OF THE OHIO RIVER LOCK AND DAM CONCRETE-MIXER BOAT

pyramids. The sand bins—the smaller pyramids—are built within the larger pyramids, or gravel bins, in such a way that both have the same forward face. The inverted-V bulkhead that divides the two gravel bins from each other serves the same purpose for the sand bins. Thus, the aft and outside corner of each sand bin is supported upon the gravel-bin beams by a wrought-iron pipe column. As a result the "booming" by the derrick boat-operator is reduced to two positions, it is unnecessary to keep a boy on top of the bins to coach the operator, and the center of gravity of each bin is brought as close as possible to the center line of the boat. The latter feature reduces the amount of side listing of the mixer boat due to unequal loading of the bins.

Estimates of the stability of the mixer boat which were made when the designs had progressed sufficiently to per-

proper angle. Then the mixer boat was run bow on against the bank, and the two portions were joined. That half of the boom which after erection may be described as the lower portion was put together on light falsework about 25 ft. above the water surface. The upper portion was built out from the lower as a cantilever. Then the mixer boat was placed so that the legs of the A-frame straddled the boom, and the latter was hoisted into place.

In operation at full capacity 11 men are needed on the mixer boat, as follows: One foreman, one fireman, one laborer on the cement platform at the receiving end of the conveyor, one laborer at each of the two cement hoppers, one laborer at each of the two aggregate hoppers, one laborer who dumps the mixers, one hoisting engineer, one laborer at the receiving hopper on the hoist tower and one oiler. In addition a watchman is employed.

Besides the men engaged directly on the mixer boat the following men are necessary to provide sand, gravel and cement: Cement scow, four; derrick boat, two; sand and gravel digger, four; towboat, two. An additional group of men are needed to load the cement scows from freight cars, but the number varies with local conditions.

TABLE 1. DRAFT, METACENTRIC HEIGHT AND ALLOWABLE WIND PRESSURE ON MIXER BOAT

Description of Loading Mixer Boat		Maximum loading; bins full and 100 lb. of concrete per lin.ft. on boom and trussed chute	Minimum loading; bins empty and no concrete on boom or trussed chute	Maximum probable working loading; bins full and 5,000 lb. concentrated load on end of boom	Probable average working loading; bins half full and 5,000 lb. concentrated load on end of boom	Maximum waiting loading; bins full and no load on boom	Probable loading when moving boat; bins half full and no load on boom	Probable loading during erection; bins empty and no load on boom
200 ft. boom	Draft in ft. at forward end	5.5	4.5	4.8	4.8	4.2	4.3	4.4
	Draft in ft. at aft end	4.9	1.9	5.5	3.6	5.8	3.8	1.9
	Metacentric height in ft.	6.5	27.5	7.5	15.0	9.0	17.0	28.0
180 ft. boom	Draft in ft. at forward end	5.2	4.3	4.6	4.6	4.0	4.2	4.3
	Draft in ft. at aft end	5.2	2.0	5.7	3.7	5.9	4.0	2.0
	Metacentric height in ft.	6.5	27.5	7.5	15.0	9.0	17.0	28.0
163 ft. boom	Draft in ft. at forward end	4.8	4.1	4.3	4.4	3.9	4.0	4.1
	Draft in ft. at aft end	5.4	2.1	5.8	3.9	6.0	4.1	2.2
	Metacentric height in ft.	7.5	29.0	8.5	16.0	10.0	18.0	29.5
Allowable side wind pressure in lb. per sq.ft. with lowest point on gunwales at surface of water	200 ft. boom	3.5	15.0	4.0	10.0	3.5	13.0	16.0
	180 ft. boom	4.5	17.0	4.0	11.0	3.5	14.5	17.5

Under the district regulations as to the amount and rate of mixing concrete the mixer boat has no difficulty in maintaining an output of 60 batches of 1 cu.yd. each per hour. By disregarding these regulations an experimental run has shown that this could be increased to 80 batches and with a little pressure could be kept as high as 100.

Operations on the mixer boat, connected with the mixing of concrete, consumed in seconds, when the output was 60 batches per hour, the following average times: Filling sand hopper, 15 to 20 (this could be reduced materially by increasing the size of the outlet from 8½x12 in. and placing it at the bottom of the bin instead of on the side); filling gravel hopper (outlet 12x16 in.), 3 to 5; discharging sand and gravel hopper (outlet 12x18 in.), 20; emptying and filling sand and gravel hopper, adding water to mix, keeping tally on batch number (one complete operation), 60; dumping mixer, 15; returning mixer to upright position, 10; filling hoist bucket from the instant of starting to dump mixer, 20; hoisting bucket and dumping (without haste), 15; lowering bucket and placing ready for concrete, 7; receiving cement bag from conveyor, hauling 10 ft. to cement hopper and returning to position at head of conveyor, 3 to 5; emptying four cement bags into hopper (not including the cutting of wire tying bags), 15.

TABLE 2. MATERIAL USED IN CONSTRUCTION OF MIXER BOAT*

Item	Steel, Including Bolts, Washers, Castings, Nails, Sheaves, in Pounds	Timber, Including Oregon Fir, Yellow Pine and Oak, in Feet B.M.
Hull	32,000	91,000
Sand, gravel and coal bins	24,000	49,000
Hoist tower, with stiff-legs and platform	36,000	200
A-frame, shoe and struts	63,000	.....
Boom, with chute and yoke	36,000	1,200
Sand, gravel and cement hoppers and miscellaneous details	11,000	.....

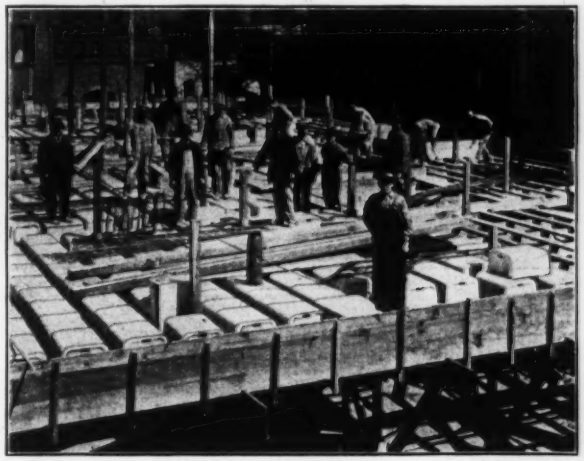
* In addition there was about 7,500 lb. of wire rope, sockets, turn-buckles, etc.; as well as 3,000 lb. of miscellaneous material, such as oakum, asbestos, paint, etc.

The mixer boat has not proved unwieldy. It has been demonstrated that a movement for about 100 ft. in a direction parallel to its longest dimension will take about 15 min., if done without assistance from another boat. It will take about 45 min. more to turn the mixer boat through an angle of about 90°, dodge a derrick with the lower end of the boom and place the boat bow on against the cofferdam ready for use. All the movements mentioned were made with lines to the nigger heads of the conveyor and hoisting engines.

The mixer boat, with the exception of the hull, was designed by the writers under the general direction of Maj. T. H. Jackson, Corps of Engineers, U. S. A.; and Guy B. Bebout, Assistant Engineer, Wheeling, W. Va. The steel for the boom, A-frame, hoist tower and stiff-legs was fabricated by the Terry & Tench Co., Inc., New York City. Other miscellaneous steel was fabricated by the Penn Bridge Co. The boat was built under the general direction of George C. Ross, Assistant Engineer, with R. I. Stewart as foreman in direct charge.

Gypsum Filler for Concrete Floors

A type of floor construction employed recently in some large buildings consists of a reinforced-concrete T-beam slab with gypsum filler tiles in the spaces between the beams or ribs. These tiles are hollow boxes, closed on all sides, the solid ends tending to reduce loss of concrete at the joints when the concrete is poured. The bottom makes a good surface for the interior plastering. The tiles are 24 in. long, 19 in. wide and 7 to 13 in. deep, being made 1 in. deeper than the concrete ribs. The thickness is ¾ in. for the top and bottom and 1 in. for the sides, with a sheet of steel reinforcement extending entirely around the tile. The weight is 24 and 33 lb. per lin.ft. for the 7-in. and 13-in. tiles respectively.



FLOOR WITH GYPSUM TILES READY FOR CONCRETING AT THE CASTLE HOTEL, OMAHA, NEB.

The top corners are rounded, and the bottom part of each side is flared so as to hold a filler or spacer tile that serves as the bottom of the form for the rib and also gives an unbroken surface for the plastering. The tiles serve as forms for the ribs and floor slab. Only light falsework is required to support the tiles during the construction of the floor. The top of the falsework consists of 2x8-in. planks, 24 in. c. to c., each supporting the edges of two rows of tiles and the spacer tiles.

This construction has been used in the Dawes Y. M. C. A. Hotel, at Chicago, and the Castle Hotel, at Omaha, Neb. The tiles are manufactured by the United States Gypsum Co., of Chicago.

Mixing Concrete Dry at a Central Plant

First-Prize Concrete Dry-Mixing Article in the "Engineering News" Prize Contest

By H. F. LaBrecque*

The problem of dry mixing and the economic effects of varying percentages of water added to the concrete at a central concrete-mixing plant were recently dealt with by the writer in putting into operation a plant designed and constructed by him on the contract for section 1, Route 29, of the New York Rapid Transit R.R.

A general view of the plant is shown in the accompanying illustration. It consists of: (1) A crushing unit, with 30x13-in. jaw-type crusher, sizing screens and bin, and a 16-in. belt conveyor running on an incline from the sizing bin, for storage piling. (2) A transporting unit, consisting of a 20-in. belt conveyor running in a 6x6-ft. tunnel from the sizing bin, underneath the stone and sand storage piles, to the foot of an 18-in. bucket conveyor, which receives the material and conveys it to the bins over the mixer. (3) The mixing unit, in which are placed a 1-cu.yd. mixer, measuring hopper, cement elevator, sand screen, of the revolving type, which also separates the gravel of specification size and deposits it in the stone bin; bins for 100 cu.yd. of stone and 50 cu.yd. of sand; and a 2000 bbl. capacity cement shed.

LAYOUT OF CONCRETING PLANT FOR SUBWAY CONSTRUCTION IN BROOKLYN

The plant is electrically operated throughout and will furnish 150 cu.yd. of concrete in 8 hr. Sand and stone are stored directly over the tunnel and fed to the 20-in. belt conveyor through a longitudinal opening in the tunnel roof. This opening is covered by short removable boards, which are taken up only at the point where feeding is in progress. It is generally found convenient to feed the stone to the transporting unit directly from the sizing bin and thus save the cost of rehandling.

The operating gang, exclusive of crusher force, consists of one man operating mixer, one man feeding cement to mixer; one man feeding cement to elevator, one man changing chutes and leveling bins, and one man feeding sand and stone to tunnel belt.

It has been found economical on this work to use steel back-dump carts in transporting the concrete to place. These carts are drawn by two horses and carry two six-bag batches conveniently.

The concrete is dumped onto the street decking a few feet away from a 42x13-in. steel hopper set flush with the top of the decking. It is then easily shoveled into the hopper, enough water being added to bring it to a working consistency, and deposited directly into the forms through steel pipe chutes.

Experiments were made in order to determine the most economical percentage of water to be added at the mixer and also to ascertain the advisability of using a dry mix. In making comparisons the items considered were: (1) Labor charge; (2) effect on transportation; (3) effect on mixer. The concrete is a 1:2:4 mix and is subject to Government inspection.

With the dry mixture the aggregates were proportioned and thoroughly mixed without water. On being dumped at the hopper a long-nozzle hose, discharging toward the hopper, was pushed through the pile and two laborers with hoes pulled the dry mixture through the water into the hopper. The load was deposited in about four minutes. It was found that a marked separation of the fine and coarse aggregates took place, due to dumping from mixer to cart, from jolting during transportation and from dumping load at hopper. It was also found that the mixing as effected by the laborers with hoes was insufficient to insure a well-mixed concrete. For these reasons it was required that six laborers, three on each side of the pile, take the place of the two, and that the mixture be turned over three times. This required from 12 to 15 min. to deposit a load.

Wet mixtures were experimented with also. Water was measured in a Ransome automatic measuring tank, which can be set to discharge the quantity of water desired. Varying amounts of water, equal to from 3 to 8% of the total volume of loose aggregate, were added to the concrete at the mixer. The higher percentages produced what would be called a good working concrete at the forms. During transportation, however, excessive free water and grout settled at the surface of the load. This either

*With Newman & Carey Subway Construction Co., Inc., 1228 Nostrand Ave., Brooklyn, N. Y.

dropped over the back of the cart or was lost when the load was dumped. Compact settlement also took place in the cart. The concrete would not dump and was picked out of the cart with marked difficulty. More water had to be added at the hopper to obtain a working consistency. It took four laborers from 7 to 10 min. to deposit a load.

The drier mixtures were easily dumped at the hopper and produced little free water during transportation, but they adhered to, and built up so rapidly in, the mixer that their use had to be abandoned.

By varying the percentage of water between these limits it was found that a batch to which about 5% of water had been added gave a maximum working efficiency and minimized the disadvantages mentioned. Three laborers deposit the load in from 3 to 5 min.

In each case a foreman and three laborers were required to spade and deposit the concrete in the forms and, in addition to the force already mentioned at the hopper, completed the concrete gang.

The average haul is 0.75 mi. No disadvantages resulted in wetting the mixture and, as the economy is apparent, this method is being adopted.

There is always danger that some accident may occur to detain a loaded cart en route. This would be especially dangerous where the haul is long and where the load might be condemned on the ground that the set would be broken. Under such conditions dry mixing would be advantageous. A modification of the central mixing plant, eliminating the mixer and only proportioning the batch, would seem preferable, since dry mixing can be given little, if any, value there.

Resurfacing an Old Macadam Road with Monolithic Brick Pavement

By Harlan H. Edwards*

A thin-base (1- to 2-in.) monolithic brick pavement placed upon the prepared surface of an old macadam road makes a good permanent road surface. In this construction the first and most important step consists in the proper preparation of the subgrade for the slab.

The worn macadam surface should be loosened to the desired width and depth with a scarifier and a harrow applied to break up the lumps and smooth off the surface. A road grader can then be made use of to remove the excess stone and leave the subgrade nearly at the required crown. This stone should be moved to one side for use in the shoulders after the pavement has been completed. Suitable ditches, culverts, catchbasins and crossdrains should be provided where necessary. The subgrade should be rolled to a uniform, compact and even surface with a 10-ton roller, and will then be ready for placing the materials.

Upon the subgrade thus prepared the concrete materials should be distributed in the most economical way. A good ¾-in. graded gravel or stone should be used. The brick should be stacked along the side of the road in such order that they may be laid in the pavement with the minimum confusion and delay, while the sacks of cement may be placed on racks to keep them off the ground.

*Urbana, Ill.

Fine builders' sand, graded to pass a No. 16 screen, should be used for the joint grout. This should be put in sacks at the cars and placed along the road with an equal number of sacks of cement, so as to provide a uniform mix, with no loss of material or time in measuring.

Steel forms 5 in. high should be used. These are set true to line and grade, 500 to 1000 ft. in advance of the mixer. With a mixer of 8 cu.ft. capacity, which is sufficient for this work, two men can easily lay and strike off the concrete base for 1000 ft. of 9-ft. pavement in from 8 to 10 hr.—enough to keep ahead of the bricklayer at his fastest rate.

The concrete, mixed to a quaky consistency, is spread out between the forms and struck off to an even surface with a saw-board templet. The bricklaying should be carried on about 25 ft. from the mixer, thus giving the concrete time to lose the excess water and become sufficiently stiff. The brick will then be properly embedded when rolled to a smooth, even surface with an 800-lb. water-ballast hand-roller. Inspection should be made at this time, and all rough, broken or cracked bricks either turned over or taken out of the pavement.

The brick should be grouted immediately after the rolling is completed, taking care that the grout is of such consistency that all the joints are completely filled. The excess grout is cleaned off flush with the top of the brick. All operations should be within 100 ft. of the mixer.

After the grout has set sufficiently hard, a 2-in. layer of earth should be put on and kept moist for 10 days, and traffic should be kept off for at least three weeks. The earth should then be removed and the shoulders shaped and made ready for traffic.

The organization for this work usually requires 26 men. Ahead of the mixer are two men setting forms, three wheelers for the sand and gravel, one cement man, one fireman and mixer operator. On the other side of the mixer are two men spreading and striking off the concrete, one bricksetter, two batters, six carriers, two stackers (if brick are carried in by tongs), one inspector, one roller, three men to the grout machine, and one for pulling forms, covering and wetting down the pavement. In charge of these men, of course, there must be a competent foreman. A water-boy is generally required. With such an organization under ordinary conditions from 700 to 1000 lin.ft. of 9- or 10-ft. pavement can be laid satisfactorily in one 10-hr. day.

No expansion joints are needed in this pavement; but if desired, thin strips of tarred paper may be placed through the slab at intervals of about 35 ft. These would act as contraction joints, eliminating the danger of contraction cracks forming in a jagged line across the pavement, with the accompanying possibility of having several bricks loosened by traffic.

A Nonsuit in Stagnant-Water Litigation—An attempt to collect damages for the death of a 9-year-old boy from pneumonia alleged to have been due to a pool of stagnant water in the street in front of the residence of the boy recently failed in the lower court, and the decision was upheld in the higher court (Bruggeman vs. City of York, Penn., July 1, 1916; 98 Atlantic Reporter, 970). Two physicians testified that in their opinion the death of the boy was the result of the unsanitary surroundings, though admitting that both his anæmic condition and his infection with pneumonia might have been due to other causes. An abstract of the decision with reference to a typhoid-fever case suit (Gosser vs. Ohio Valley Water Co., 244 Penn. 59, 90 Atl. 540, Ann. Cas. 1915C, 685) is given in United States Public Health Reports, Jan. 5, 1917, p. 23.

Deflection and Wall-Girder Tests on Floor of a Flat-Slab Concrete Building

By C. E. Locke*

SYNOPSIS—Deflection measurements and cracks give important information on behavior of flat slab under load, together with data on column bending and wall-girder stresses.

A test of a reinforced-concrete flat-slab floor recently made on building J of the plant of the Pierce Arrow Motor Car Co., Buffalo, N. Y., showed interesting results. This building had just been completed by the contractor, Aberthaw Construction Co., of Boston, Mass. Two adjacent wall bays on the fourth floor were chosen for the test, since the smallest columns there would have the least effect in restraining the action of the floor slab, and it was believed to be the most severe test to load the wall bays only. A brief outline of the structural features of the building, as designed by the contractor, is as follows:

The floor slab is designed for 200 lb. live-load, 120 lb. dead-load; the slab is 9 in. thick plus 1 in. finish; the drop panel is 7 ft. square, 5 in. thick; the interior column head is 60 in. in diameter; the wall columns have a bracket, as shown on the drawings. Over the interior column heads are two 1-in. round rings 4 ft. 6 in. and 9 ft. in diameter. Eight 1-in. round radials are bent down into the columns. Half-rings with five radials each are placed over the wall columns. The bands of floor steel are designed according to the Chicago building code and placed as is customary with the four-way system of reinforcement. In the wall bays both the rectangular and diagonal bands have twenty-two ½-in. round rods. Nine ½-in. round rods are placed as half a rectangular band along the outside of the bay. The steel is 2 in. below the top of the slab over the columns and 1 in. above the bottom of the slab in the center. At right angles to the rectangular bands are placed fifteen ½-in. round rods in the top of the slab. Interior bays have eighteen ½-in. round rods in each band. The roof slab is 7 in. thick. The parapet wall beam is 9 in. wide, 38 in. deep.

The wall-beam reinforcement is shown in Fig. 1 and the column schedule in Table 1.

TABLE 1. COLUMN SCHEDULE

Columns	Size	Mix	Vertical Steel	Hoops
Fourth story wall	24x16-in.	1-1½-3	Four 1-in. round	⅜-in. round, 12 in. c. to c.
Fourth story interior	20-in. round	1-2 -4	Four 1-in. round	⅜-in. round, 12 in. c. to c.
Third story wall	24x18-in.	1-1½-3	Four 1-in. round	⅜-in. round, 12 in. c. to c.
Third story interior	22-in. round	1-1½-3	Four 1¼-in. round	⅜-in. round, 12 in. c. to c.

The columns, floor and wall beam were concreted July 1. Bags of gravel and cement were used for the load.

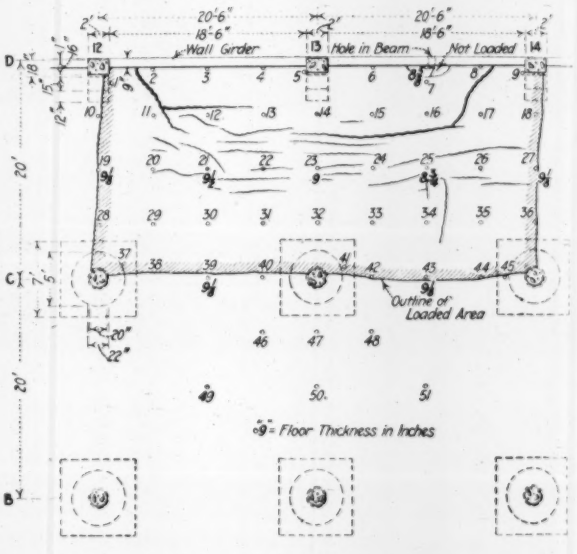


FIG. 2. PART OF FLAT-SLAB FLOOR UNDER TEST WITH CRACKS UNDER MAXIMUM LOAD

These were placed by layers, the first layer on Aug. 2 and the last on Aug. 12. The final load of 600 lb. per sq.ft. remained until Aug. 14, when the unloading commenced in order to use the material to finish other parts of the building. This tested the floor, then six weeks old, to about two and a quarter times the total design load, or three times the design live-load. Loading beyond 600 lb. was stopped, as it was not desirable to take the chance of permanently damaging the building by stressing the structure beyond its yield point.

Deflections of the Floor Slab

Floor-slab deflections at various points were measured by means of an engineers' Wye-level and rod readings on the ceiling below. Two levelmen reading the same rod at the same time obtained quite consistent results. The

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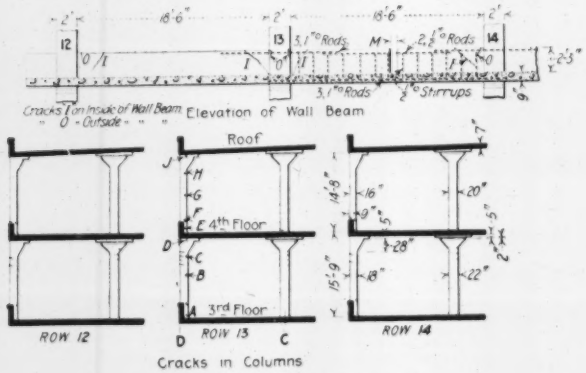

Deflections of Columns [in Inches]

Point	Moved	450 lb Load	600 lb Load	150 lb Load	Not Loaded	No Load
A		0.0	0.00	0.00	0.00	
B	Out	0.07	0.13	0.06	0.05	
C	"	0.09	0.15	0.07	0.05	
D	"	0.04	0.06	0.04	0.02	
E	In		0.05			
F	"		0.10			
G	"		0.05			
H			0.00			
J			0.00			

FIG. 1. ELEVATION OF WALL BEAM AND OF COLUMNS UNDER LOADED SECTION

Showing cracks and, in table, column deformations

TABLE 2. FLOOR DEFLECTIONS IN THOUSANDTHS OF A FOOT; NEGATIVE UNLESS MARKED +

Loaded	8-7-16	8-9-16	8-10-16	8-11-16	8-12-16	8-17-16
Reading	8-8-16	8-10-16	8-11-16	8-11-16	8-14-16	8-18-16
Loads, Lb.	350 Lb.	450 Lb.	500 Lb.	550 Lb.	600 Lb.	0 Lb.
Points						
1	0	0	..	..	4	0
2	2	4	..	..	8	3
3	2	3	..	..	7	1
4	2	5	..	..	9	4
5	1		..	..	4	+1
6	4	4	..	..	9	2
7	5	6	7		12	6
7'	11	17	21	21	28	14
8	5	6	..	..	12	6
9	3	1	2	4	5	2
10	4	7	..	..	15	4
11	10	16	..	..	29	9
12	13	19	..	..	37	15
13	14	22	..	..	33	15
14	10	15	18	20	27	11
15	14	20	..	..	37	14
16	17	27	..	..	43	22
17	12	18	..	..	29	16
18	5	6	..	..	14	5
19	7	11	..	..	20	7
20	14	20	..	..	37	12
21	19	29	26	36	50	21
22	21	30	39	..	52	22
23	18	29	33	37	49	19
24	21	32	36	..	54	22
25	21	35	42	47	59	26
26	23	34	29	..	42	20
27	11	13	..	..	23	13
28	6	6	..	..	12	5
29	9	13	..	..	23	8
30	14	19	..	..	31	12
31	14	19	..	..	36	17
32	12	17	24	24	31	12
33	16	21	..	..	36	16
34	18	26	..	..	44	20
35	16	19	..	..	32	15
36	7	6	..	..	14	7
37	4	4	5	6	5	+2
38	5	4	..	..	9	2
39	7	7	..	..	16	6
40	7	5	..	..	11	5
41	2		..	..	12	1
42	6	5	..	..	13	9
43	12	13	..	..	24	13
44	6	7	..	..	13	6
45	3	2	5	5	9	4
46	1	+2	..	..	2	3
47	2	+2	..	..	+1	3
48		0	..	..	2	6
49	2	+1	..	..	+2	3
50	0	+3	..	..	+2	1
51	1	+1	..	..	+1	4

averages of accepted consistent readings are tabulated in Table 2. Many of the apparently inconsistent deflections may be accounted for by the varied thickness of the rough floor, shown at various points in Fig. 2. The position of the load as indicated by the outline of the loaded area probably had some effect. Readings taken the day after all load was removed showed an average recovery of about 60%. Further readings, a week later, indicated no further recovery. Even while yet subjected to a severe overload, the floor showed considerable recovery when a part of the load was removed, which shows that the floor was not stressed beyond its yield point. Fig. 4 shows a curve of the average deflection of the five lowest points with the varying load. The curves for different loads showing the shape of the slab at the middle of the two bays indicate that points 21 and 25 would have deflected more had the adjoining bays been loaded, whereas point 23 would probably not have been affected.

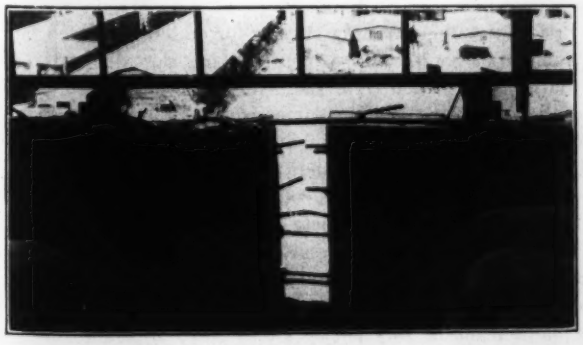

FIG. 3. WALL BEAM CUT TO FACILITATE MEASUREMENTS

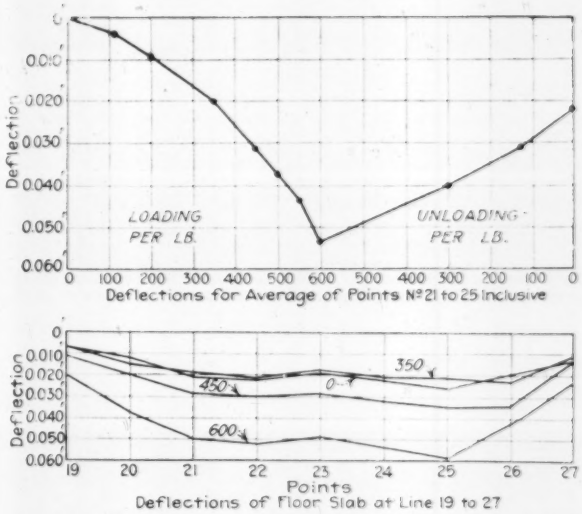

FIG. 4. DEFORMATION CURVES IN MIDDLE OF SLAB

Cracks in the floor slab, shown in Fig. 2, were noticed at about 450-lb. load. Most of these cracks were visible only upon close inspection. The two largest cracks, as indicated by heavier lines, were quite visible 10 ft. away. Had the adjacent wall bays been loaded, points 10 and 18 would have deflected more; then this large crack would probably have continued longitudinally instead of turning off toward the wall beam. As the load was removed, the cracks were less noticeable, but the larger ones can still be seen quite plainly. The load was first removed around columns *D*-13 and *C*-13, the floor swept clean and the top of the slab inspected to see if any cracks developed there. None were found, although fine hair cracks could not have been detected in the very rough surface of the slab.

Bending in the Columns

The effect of the test load upon the columns was quite serious. The cracks which developed are shown in Fig. 1. Even the columns at corners of the loaded area were affected, thus showing the serious condition of eccentric loading. The interior column cracks closed up entirely as the load was removed, but wall-column cracks, especially in the center column, are still apparent. When the floor was loaded about 100 lb. per sq.ft., points *A* to *D* were marked in a vertical line on column *D*-13, by means of a transit. Later at different loads the deflections were measured from a vertical line assuming that point *A* had not moved. The very large deflection of 0.15 in. was observed at point *C* at the center of the group of cracks. The compressive stress in the concrete at *C* certainly must have been exceedingly high, as the cracks extended halfway across the column. A crack developed at *F* which was the widest of them all, and this one apparently nearly cut the column in two parts. The effective thickness is only 14 in. at this point, as a slot is left for the window sill to be concreted later. At full load, points *E* to *J* were marked in a vertical line and the recovery noted at no load. This amounted to 0.10 in., assuming that point *J* is stationary.

From the size and extent of the cracks and comparative deflections, it is quite evident that the wall columns are the weakest parts of this design. A better-balanced

design would either provide for the excessive stresses caused by bending moment in these wall columns or provide sufficient strength in the floor itself to carry the load with but little assistance from negative resisting moment over the wall columns.

Investigation of Wall Beams

In view of the fact that half a typical rectangular band was placed along next to the wall beam, the writer believed that the wall-beam steel was unnecessarily heavy; therefore, in one of the wall beams a slot 8 in. wide was left down to the floor slab, which would nullify to a large extent the value of the three 1-in. round rods in the bottom of the beam, thus leaving the load to be carried only by the band in the floor slab and the two

TABLE 3. DISTANCES M BETWEEN STEEL POINTS AT SLOT IN BEAM

M	Load Lb.	Temp., Deg. F.	M	Load, Lb.	Temp., Deg. F.
4.221	0		4.203	470	84
4.223	56	76	4.202	497	80
4.217	56	88	4.198	551	90
4.223	56	83	4.206	551	70
4.214	100	95	4.205	604	79
4.220	100	86	4.201	604	62
4.224	172	73	4.198	570	66
4.220	172	82	4.197	570	80
4.209	354	94	4.196	430	85
4.211	354	83	4.200	354	82
4.209	354	87	4.208	...	87
4.216	354	79	4.212	...	82
4.208	444	87	4.224	...	65
4.209	444	85			

half-beams each acting as a cantilever out from the column. This slot and reinforcing steel are shown in Fig. 1. The ½-in. rods in the top of the beam were cut and the ends of one of them filed to a point, as shown in the accompanying view (Fig. 3). The extra rods are for temperature and shrinkage stresses. One of them was bent before the load was applied. Readings of the distance *M* between the points of the rod were made with an inside micrometer, and are shown in Table 3. The total variation of this distance was only 0.028 in., so that the changes of temperature caused more variation than a small increase in load.

These readings only show how small the deflection really was; and they might have been useful to indicate any sudden drop of the beam, had there been any such fact to observe. The maximum deflection at point 7, just below the slot in the beam, was only 0.012 ft., which was not sufficient to affect the 12-ft. high steel sash then in place and glazed below. Considering these small deflections and the lack of any cracks to indicate any failure due to this slot in the beam, the writer believes the reinforcing steel in this beam could have been very materially reduced without sacrificing any desirable strength. The stirrups and the hooked ends of the floor rods tied the beam and floor together. The cracks observed in the wall beam did not run clear through, but were different on the outside than on the inside of the beam, as shown in Fig. 1. Apparently, the top of the beam moved in toward the load, as the floor deflected more at points a few feet away from the beam than at the beam itself. The columns, being more rigid, probably deflected less than the beam, thus producing torsion at each end of each beam, causing the cracks, as shown. As these were only fine hair cracks, the results do not indicate any weakness in this particular design, but only add one more complication to consider in the design of flat-slab floors.

Safer Water for Bay City Urged in Report and Campaign

The need for uptodate water-works and the present dangers from typhoid due to a supply polluted at times are set forth convincingly in a report on the water-works of Bay City, Mich., made recently by Burns & McDonnell, consulting engineers, Kansas City, Mo. Many illuminating diagrams showing typhoid dangers at Bay City and how these have been reduced by water purification elsewhere are included in the report. These diagrams are being used in lantern-slide form in a campaign for an $850,000 bond issue for carrying out improvements to the works recommended. The whole report, it may be added, is well designed to convince the average citizen, as well as the city officials, that the whole water-works system is in bad need of overhauling and that there is particular need for a purer supply.

A 30-in. wood-stave pipe line, 4 mi. long, in use about 45 years, is an interesting element in the original Bay City water-works, put in use in 1872. This pipe line extends from the original, or East Side, pumping station, to a dredged channel, protected by breakwaters, extending nearly a half-mile into Saginaw Bay, to a point about 2½ mi. east of the mouth of the Saginaw River. The city is built on both sides of the river and discharges its sewage into that stream. With increasing frequency the city has drawn a part of its supply directly from a badly polluted portion of the river, as stated in the following extract from the Burns & McDonnell report:

> The capacity of the 30-in. wood-stave pipe, which serves as the supply line for the East Side station, was tested when first installed over 40 years ago and was reported to be more than 8,000,000 gal. per day with the water in the wells lowered 5 ft. In 1879 an 18-in. emergency intake to the river was installed; in 1884 the full capacity of the main conduit was reported to be 5,000,000 gal.; in 1896 the emergency river intake was enlarged to 30 in. The present capacity of the bay conduit apparently is not more than 4,000,000 gal. per day, indicating that there has been a steady decrease in the capacity of this pipe line. This line is over 40 years old and is undoubtedly in poor physical condition and partially filled with sand and mud. Consequently, the river intake, which was originally intended to be used only in case of great emergency, has been resorted to more and more frequently, and during the last three years it has been at least partially open on more than half the days of the year. All the water which the bay conduit will carry is utilized, and the deficiency is made up by opening the valve on the river intake enough to supply the demand.

The river intake draws from a bayou into which city sewers discharge—one 100 ft. and two 1500 ft. from the emergency intake. The river receives not only sewage from Bay City, but also from Saginaw, Flint, Owosso and other places above.

The East Side (East Bay City until consolidation with Bay City in 1905) is supplied from an independent water-works plant, the pumping station for which is located on the shore of Saginaw Bay about 2¾ mi. west of the river mouth and 4 mi. north of the city. A 40-in. riveted steel intake pipe, 2200 ft. long, extends from the suction well to a submerged timber crib, in water 10 or 11 ft. deep. This intake has always met the demands upon it, except that for a few times, only, anchor ice has caused trouble, but never a complete shutdown.

The water delivered by each of the two pumping stations is treated by liquid chlorine, but during the three months preceding the report there were many cases of typhoid fever in Bay City. From Aug. 7, 1916, "when daily tests were begun by the city bacteriologist, the

average number of bacteria in the raw river water was 2200 per c.c. and in the treated water 3200; in the raw Bay water 3680 and in the treated water 560." The water supplied the West Side showed an average of 3260 raw, and 210 chlorinated. Besides its unsatisfactory bacterial quality the water is subject to considerable turbidity.

The average typhoid rate of Bay City for the 11 years ending with 1916 (one month short) was 38 per 100,000, while the rate for 1916 alone (one month short) was 32.

Estimates of the cost of putting the Bay City waterworks in good shape total $881,500, but of this it is advised that $64,000 for a new intake crib and pipe be postponed and $20,000 for meters be provided from revenue. The remaining sum of $837,375 includes as its chief items the following: Four 5,000,000-gal. steam-turbine-driven centrifugal pumps, with foundations, all complete, $33,000; 2,000,000-gal. reinforced-concrete settling basin (3½ hr. detention), $80,000; mechanical filter plant, including 10 concrete units with effective area of 540 sq.ft. each, 800,000-gal. clear-water well, brick filter house and all piping, etc., $200,000; one 10,000,000-gal. cross-compound high-duty crank-and-flywheel pumping engine, $37,500; boilers, $29,000; 36-in. cast-iron force main, $290,000; 24-in. flexible-joint cast-iron pipe under river, $72,000; replacing wood distribution mains with cast iron, $72,000; new feeders in distribution system, $35,000.

Apparatus for Mixing Soap and Alum Waterproofing with Concrete

By Homer V. Knouse*

In relining the slopes of basins 1 and 2 of the Walnut Hill reservoir at Omaha, Neb., as described in *Engineering News* of Oct. 5, 1916, waterproofing consisting of bar soap and sulphate of alumina was added to the tempering water before it entered the gaging tank on the

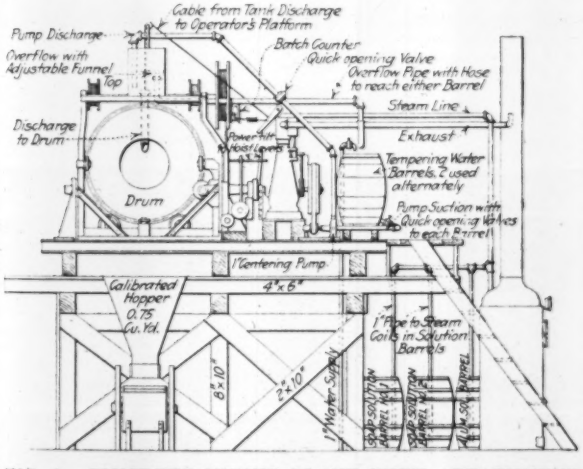
Cable from Tank Discharge to Operator's Platform
Pump Discharge
Overflow with Adjustable Funnel Top
Batch Counter
Quick opening Valve
Overflow Pipe with Hose to reach either Barrel
Steam Line
Exhaust
Discharge to Drum
Tempering Water Barrels, 2 used alternately
Drum
Pump Suction with Quick opening Valves to each Barrel
Tempering Pump
Calibrated Hopper 0.75 Cu. Yd.
1" Pipe to Steam Coils in Solution Barrels
1" Water Supply
Soap Solution Barrel No. 1
Soap Solution Barrel No. 2
Alum Sol. Barrel

FIG. 1. CONCRETE-MIXING PLANT WITH ATTACHMENT FOR ADDING WATERPROOFING TO MIX

top frame of the mixer. To obtain an accurate control of the quantity of these materials applied per cubic yard of concrete, special devices were fitted on the No. 11 Smith mixer performing the work.

*Construction Engineer, Metropolitan Water District of the City of Omaha, Omaha, Neb.

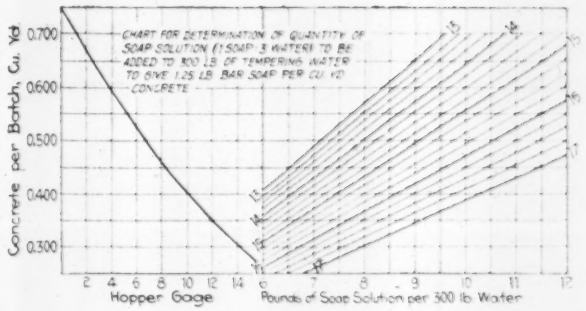
CHART FOR DETERMINATION OF QUANTITY OF SOAP SOLUTION (1 SOAP: 3 WATER) TO BE ADDED TO 300 LB. OF TEMPERING WATER TO GIVE 1.25 LB. BAR SOAP PER CU. YD. CONCRETE
Concrete per Batch, Cu. Yd.
0.700
0.600
0.500
0.400
0.300
Hopper Gage
Pounds of Soap Solution per 300 lb. Water

FIG. 2. CHART FOR DETERMINATION OF QUANTITY OF SOAP WATERPROOFING SOLUTION

Common bar soap was placed in a 25% solution in barrels on the ground level, the action being hastened by the use of steam coils. A 25% solution of sulphate of alumina, such as serves as a coagulant in water-works practice, was obtained in a third barrel, all so located that the fireman at the boiler could do the necessary work of charging and stirring. Two calibrated barrels on the mixer level were used for preparing the tempering water and were connected to the suction side of a 1-in. centrifugal pump so that each could be used while the other was being prepared. This pump discharged into the gaging tank on the top of the mixer frame, and from it the water was discharged into the drum through a lift valve in the bottom. In order to control the amount of water per batch, an overflow, discharging into the mixing barrels, was applied in the form of a funnel screwed to a long threaded nipple. This gave a large area of weir for quick discharge and allowed adjustment as the moisture content of the aggregates varied.

After mixing, the concrete was discharged into a calibrated hopper; and at frequent intervals the quantity of concrete per batch was measured, although it was found that by the methods followed in charging the skip very little variation occurred. The amount of tempering water per batch was determined by a gage on the upper tank, and from these data the proper amount of soap solution per measured quantity of tempering water was obtained quickly by use of the chart shown in Fig. 2.

Three men were required to operate this equipment—an operator, a fireman and a man to prepare the tempering water. All operating levers and valves were within easy reach of the operator, and the sequence of operations was so arranged that a maximum length of time of the materials in the drum was obtained in each cycle.

New Electric-Lamp Equipment for range lights and lighthouses has been devised by the United States Bureau of Lighthouses. The new range light has two units, each containing a 6-volt, 30-cp. concentrated-filament incandescent lamp in a silvered parabolic reflector throwing its beam through a red glass. The lamps may be run on storage-battery or city-system current, either one being automatically substituted for the other in case of failure. Also in case one lamp fails the other automatically is connected into circuit. A device for automatically replacing incandescent electric lamps burned out in service has been developed and is now in use at several lighthouse stations. The device consists of three lamp sockets mounted radially at 120° on a spring-actuated shaft, which is supported on a frame of proper height to bring the upper lamp in the focus of the lens. The shaft is held against rotation by means of a latch and ratchet wheel. Should the lamp in service burn out, the latch is released by means of electromagnets, and the shaft revolves 120°, bringing the second lamp into service. The third lamp is similarly brought into service when the second lamp burns out.

Helpful Suggestions for Surveying Country Highways

By Samuel P. Baird*

SYNOPSIS—Some pointers on special survey methods and devices from the practice of an experienced surveyor.

The fieldwork preliminary to country-road improvement is often done by young men just out of college, and a few pointers on labor-saving methods by an old-timer may not come amiss. Without further preliminaries I will make a few suggestions based on my own experience.

Run Levels First

I always run a line of levels the first thing, locating benchmarks about every 1000 ft. and near all structures. Each benchmark should be given a number, for it is quite an economy of time to record them by number rather than describing them every time they are used.

By running the levels for the benchmarks first the engineer will acquire a certain amount of information about the road, the volume and kind of travel, the names of property owners, etc., which will be an aid in running the center line.

Where an experienced rodman is available, I use a target rod for B. M. work. Both leveler and rodman keep notes to check each other. Levels are run back again unless a check can be made on a United States Government B. M. When levels are run back, check readings are taken on the benches located going out.

For all leveling except the most exact B. M. work I use a self-reading rod graduated to feet and tenths. The rods are generally 16 ft. long, graduated on both sides, the zero of the two sides being at opposite ends of the rod. This is a time saver, as rodmen will sometimes get the rod wrong end up; but with this method of graduation it is only necessary to turn the rod around instead of end for end. The rods were home made.

I have used for some time an addition to the ordinary marking of leveling rods. I have foot numbers painted on the rod just at the left of and just below the 0.2, the 0.4, the 0.6 and the 0.8 marks. This is for the convenience of the leveler on short sights, avoiding the occasional necessity of calling "raise the rod." This added feature is very inexpensive and is a time saver. The figures can be small, as they will be used only on very close sights.

Locating the Center Line

We generally try to find a center line that will most nearly bisect the portion of the highway between fences, or sometimes a center line that will most nearly bisect the old roadway as indicated by the berms and cuts. It is not essential that the center line of the survey be made the center line of the road. But if it is made so, it will simplify the work considerably. To get a center line located on either of these plans requires considerable work, unless you use a short-cut similar to the method outlined herewith.

Have a number of frames or signals prepared (see Fig. 1)—something that can be stood up on a hard road or on a frozen hillside without the labor of digging a hole. The frames that I have had the most success with are made of 7/8x7/8-in. poplar or cypress, dressed on four sides. Two 3-in. strap hinges and two small screw clamps are required for each signal. The central, or upright, pole should be about 8 ft. long; two diagonal braces should be about 4½ ft. long and the two horizontal braces about 3½ ft. long. When closed these frames nest very well for storage or forwarding purposes.

With a number of the frames ready (say about ten, depending on the length of the tangents) the work is started by locating a frame or signal at the center of the road at some governing place. Continue locating these frames at governing points on the two adjacent tangents.

With a plumb bob and line one can soon locate the intersection of the two lines of signals (or of the tangents). This point of intersection should be permanently marked and referenced. If in the traveled portion of the highway, a 60d. spike driven through a tin-roofing cap and a 4-in. square piece of canvas will generally hold the place for several months. A spoonful of road oil will be an aid in quickly locating nails at station points.

The transit line should proceed along the tangents (the points of intersection having already been located) until a little short of the probable P. C. Then the instru-

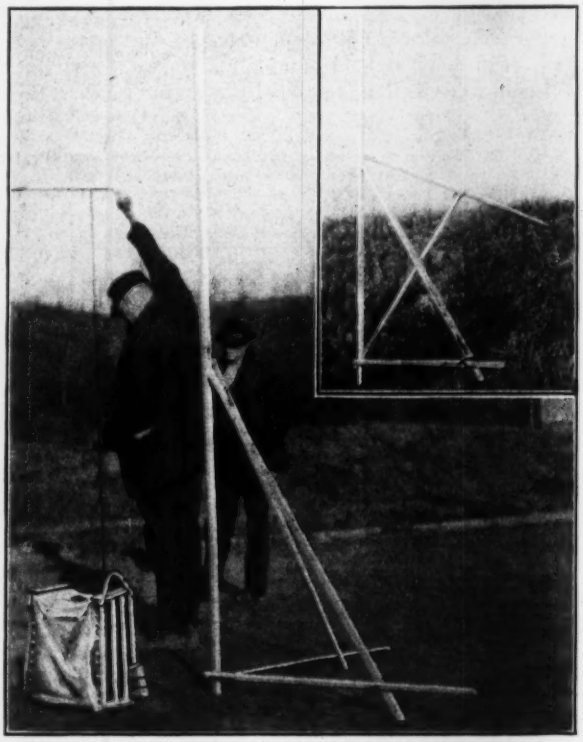

FIG. 1. DEVICES USED IN HIGHWAY SURVEYING

Above—Frame for locating center line of roadway. Below—Stake pocket and 7-ft. plumb line from special tape

*Engineer and Contractor, Columbus, Ohio.

ment should be moved up and the intersection angle and the external distance measured.

One of the chainmen, if possible, should be fully instructed in figuring the curves, so that he can check the instrumentman, thus saving valuable time by avoiding mistakes.

I use a rubber stamp or a printed-sticker form (Fig. 2) for inserting in the notebook the properly arranged curve data. This practice preserves all the curve data in a uniform record for later use.

For the length of curve I use the actual length measured along the arc, for I had the necessity of this called very forcibly to my attention in checking some concrete roadwork that had quite a number of short-radius curves. I found that there was about 50 ft. more road than the stationing indicated, and this at $2 per ft. cost the contractor $100.

In this connection I will say that the measurement on the center line should be made on the same slope as the finished road to cover the actual distance that the contractor will be required to construct the pavement. It is well to remember that the engineer is the engineer for the contractor as well as for the state, county or whoever it may be. As soon as the tangent distance is ascertained, the P. C. and P. T. stakes can be put in, preferably in the following order: First, the P. C. stake; then measure from the last station to the P. C., so that the deflection angles can be figured to make the curve points come at even stations and plus fifties. Then the P. T. can be put in while the calculation is completed. This avoids using any equation stations.

BEARING N 35° 30 W.
ANGLE TO LEFT 44° 20'
RADIUS 10° = 573.7'
TANGENT 233.7
DEF. FOR 100 FT 5° 0'
DEF. FOR 50 FT 2° 30'
DEF. FOR 1 FT 0° 3'
DEF. FOR 8.5 FT 0° 25.5'
DEF. FOR 34.8 FT 1° 44.4'
P. C. 17 + 41.5
L. C. 4 33.3
P. T. 21 + 84.8
SUB. CHORDS 8.51-34.84-50.05
BEARING N 8° 50' E

FIG. 2. STICKER FOR NOTEBOOK

Marking Survey Points

The P. C., P. T. and P. I. points should be well referenced by at least three references each. Reference stakes should be outside of the limits of the work, located preferably close to buildings, fences or trees as insurance against disturbance.

Where the intersection angle is large, it is advisable to locate a point on each tangent produced, which can be occupied as instrument points or for placing a permanent flag. Lines run without a constant foresight or backsight are not generally straight. A permanent flag will save time. In the winter when snow is on the ground I use red flags, and during other times of the year white flags, on all signals.

Some highway departments require that a spike or nail be driven at each station point; as these invariably come in the traveled portion of the road, it will be quite an aid to the work to have the chainmen equipped with a pair of 8-in. pliers to hold the spike at its midlength. This prevents to a large extent the bending of the spikes while driving.

It has been my custom to set the witness stakes not exactly opposite the spike, but an even 100 ft. from the last station spike and the distance off the line from the succeeding station that is marked on the back of the stake. This makes each witness stake act as a reference to the two station points. For instance, the witness stake at Sta. 105 is set at 100 ft. from Sta. 104 and 20 ft. from Sta. 105. On curves 50-ft. points are marked and referenced. The station numbers are painted on fences, etc.

Special Steel Tape

For all measurements along the center line I use a 100-ft. steel tape, graduated to feet, except at the ends, where the feet are graduated to tenths. Besides the usual markings I have all my tapes equipped with a clip soldered on at the 0-, 25-, 50-, 75- and 100-ft. points (see Fig. 3).

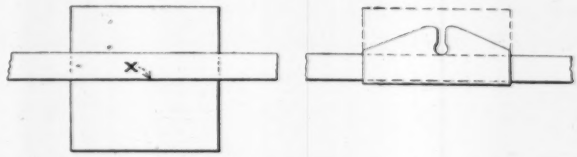

FIG. 3. CLIPS FOR HOLDING PLUMB LINE ON STEEL TAPE

The first operation is to solder on one side of the tape a piece of heavy tin as shown, care being taken not to have any solder along the edge X as it will prevent a good fold. The second operation is to fold on the line X and solder the laps together. Then trim the double, soldered laps as shown

The clips are about 1 in. long and project from the side of the tape about ¼ in. They have a slot filed in them sufficiently wide to carry a plumb line and as deep as possible without cutting into the edge of the tape. These slots are filed exactly opposite foot marks.

The advantages are twofold: The accuracy of the work is increased when using a plumb bob, as the plumb line is placed in the slot in the clip and held there with ease and certainty even when using 7 ft. of string; the clips are also very convenient in quickly locating the quarter-points on the tape.

Cross-Sectioning

For taking cross-sections the 100-ft. steel tape is placed on the ground from one station point to the next, using it as a straight-edge. The pluses are read on this tape, and the offset from it to fences, trees, poles, etc., is read with a metallic tape.

The tape used for cross-sectioning is one improvised of two metallic tapes sewed together so as to give graduations on both sides. This is a time saver. I am arranging now to have tapes graduated the same on both sides.

Cross-sections should be taken much more frequently than is customary and should be run out at least 30 ft. from the center line. The grading cost of most highway work runs about 15% of the total; and as it is usually estimated at about one-half what it actually costs, great care should be taken to see that no yardage is missed in taking the cross-sections.

It has been my plan to set side stakes opposite the points on the center line and when taking the levels along the center line for profile purposes to take levels on the ground at each of these side stakes, and to give the center-line grade on them. If these stakes are preserved (and there is no reason why they should be lost if they can be placed in the fence line), it will be possible

for the contractor or the inspector to give line and grade from them at any time.

It is my practice to give all cuts and fills from the surface of the ground at the base of the stake, except for concrete road and street work. In using this plan, even if the stake is knocked out and is not lost, the work can proceed, as the ground elevation is very likely not disturbed, while if the elevation had been given on the top of the stake it would have been lost if the stake were disturbed.

For carrying stakes I have tried straps, baskets, boxes, and have finally adopted a canvas three-compartment stake pocket. This occupies very little room when empty, it is easy to handle, keeps the stakes in order and is very much superior to anything else that I have tried or seen. It is shown in Fig. 1. It will hold fifty 1⅜x ⅞x18-in. stakes, which should all be numbered in advance, except perhaps half a dozen for use at unexpected points. The stake compartments are 2 in. wide by 16 in. high by 12 in. deep. The stakes fit snugly in the pockets, to prevent the disturbance of the serial order in which they are arranged.

Making Large Concrete Blocks for the Panama Canal Breakwaters

Limon Bay, at the Atlantic or northern entrance to the Panama Canal, is protected against the occasional norther by two breakwaters, one extending northeasterly from the west point of the bay (Point Toro), the other a detached breakwater of recent construction extending from the east point in a straight line to about 2000 ft. east of the outer extremity of the west, or Toro, breakwater. While both of these breakwaters have for their main structure heavy rock dumped from trestles, which incidentally have had to be replaced during the past year after being wrecked by northers, both have as additional protection of the slope large concrete blocks that are dumped overboard along the rock face of the breakwater. These blocks are cubes varying in linear dimension from 4 ft. 6 in. to 7 ft., the largest weighing about 25 tons. Somewhat different methods of manufacture were used in the blocks for the west and for the east breakwaters, so each one will be described separately here. About 20,000 cubes constituted the total number used. Some were built by contract and some by Government forces.

The east-breakwater blocks were built by Government forces both at Cristobal and near Coco Solo. The former plant is illustrated in Fig. 1. As will be noticed there, the plant comprises a concrete mixer mounted on flat-cars controlled by a locomotive crane, which at the same time feeds the mixer from material cars run in on an adjacent track. The concrete is delivered through chutes to the forms, which are distributed in the yard, as shown.

The detail of the forms is shown in Fig. 2. They are made up of metal-lined plank in the form of a cube with one side and the top open. In setting the form to receive the concrete, it is placed with its open side closed by a block previously poured, the side of this block being faced lightly with a coating of tar and a sprinkling of sand. As soon as the concrete has been poured into the form and the latter is ready to be removed, it is drawn back until its open end is flush with the block just cast. This block is then faced as the previous one, and the pouring of the next block proceeds as before. In order to save space, the blocks are cast in tiers of two and three. In the view in Fig. 1, for instance, the blocks in the rear are in some cases as high as the third tier.

These blocks are moved from the stacks in which they are formed to flat-cars and hauled on the Panama R.R. to the breakwater. The loading onto the cars is accomplished with a crane provided with the same sort of hook as is shown in Fig. 5, gripping openings cast for that purpose in the sides of the blocks.

FIG. 1. CASTING YARD AT CRISTOBAL FOR CONCRETE CUBES USED IN EAST BREAKWATER, LIMON BAY

For the west breakwater the blocks were cast in a special plant by contract, the Panama Canal furnishing gravel and cement delivered to the point of manufacture. The contractors had a plant at Gamboa. This comprised a wooden trestle from which the aggregate was dumped, and an adjoining traveling mixer plant mounted on flat-cars running on tracks parallel to the gravel track. Concrete was delivered to the forms by spouts, as in the other plant. The forms, however, being somewhat larger than for the other breakwater, were made stronger. Fig. 4 shows the details of one such form. The

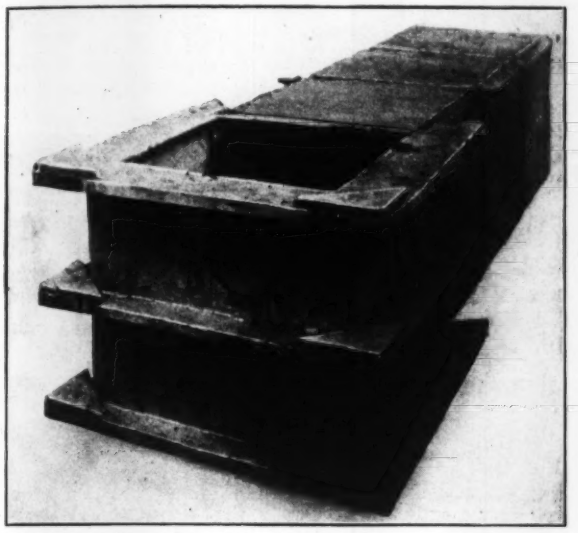

FIG. 2. FORMS FOR 5-FT. CONCRETE CUBES USED ON PANAMA BREAKWATER

two corners diagonally opposite are nailed solid. The other two corners are furnished with wedge blocks and are free to move. The two pieces of form making the four sides are placed on 9-ft. square platforms with the chamfer strips for the bottom nailed to the platform, the outside edge giving the 7-ft. square. The forms are wedged up to the chamfer strips, and the sides and tops are then placed. To remove the forms, the wedges

FIG. 3. DERRICK BARGE PLACING BLOCKS ON WEST BREAKWATER, LIMON BAY

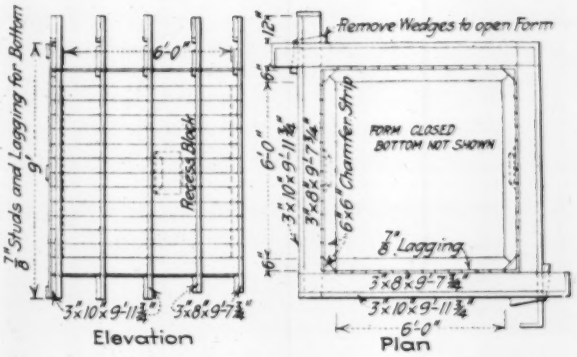

FIG. 4. FORMS FOR 7-FT. CUBE CONCRETE BLOCKS, PANAMA BREAKWATER

are taken out, the corners spread and the entire form lifted.

As in the other plant, these blocks were poured in tiers. In handling the blocks two 10-ton locomotive cranes with outriggers were used, balance being secured by additional loads on the coal and water tanks of about five tons of pig iron. The cranes had the tongs shown in Fig. 5. Each pair weighed about 2600 lb. and had a clear width when open of about 7 ft. 2 in. The channel iron that kept the jaws from closing to less than 6 ft. 7 in. was so arranged by notch and pin that when the

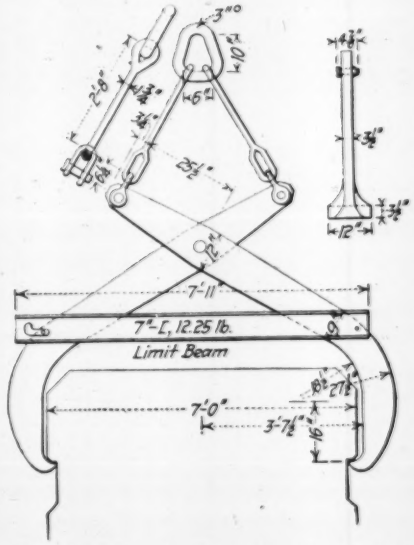

FIG. 5. HANDLING TONGS FOR LARGE CONCRETE CUBES

hook dropped over the top of the block and the jaws were open to clear the block, the channel held them open about 7 ft. 2 in., which enabled the hook to be lifted off.

These blocks were not only carried out to be placed by a floating crane, as shown in Fig. 3, but were also run out onto the breakwater trestle on cars and dragged off by the same general type of plow that is used in clearing the dirt-cars in the other parts of the Panama work.

The blocks were made from run-of-bank gravel, which, except in a few instances, ran quite uniform. Work was started with a mix of 1 : 6, but this was afterward changed to a richer mix of 1 : 4½, which proved quite satisfactory.

The average cost was about $3.90 per cu.yd., exclusive of the cement and gravel, which in the blocks made by contract was furnished by the Commission.

Drill-Sharpening Methods at the United Verde Mine, Arizona

Second-Prize Drill-Sharpening Article in the "Engineering News" Prize Contest

By Frank Richards*

The ground in the United Verde mine is hard, and as a result the steel is quite dull when it reaches the sharpening plant. This is especially true of the steel used in conjunction with the Leyner drills. The sharpeners are in continuous operation during the entire 8-hr. period. A highly efficient system of collecting, sorting and routing, sharpening and distributing has been developed at this mine.

DAILY MOVEMENT OF STEELS AT UNITED VERDE MINE

Average number of steels sharpened per day	1,800
Type of bits	Crossbits
Length of steels	2 to 10 ft.
Shanks	60% Leyner-Ingersoll drill shanks with lugs, 20% "Jackhammer" shanks with collar, 20% Stopehamer shanks without collar
Grade of steel	0.75 to 0.95% carbon
Sharpening-plant equipment	Two No. 5 Leyner sharpeners and one No. 3 Leyner sharpener, each equipped with Davies hole-blowing device; three Davies punching machines; three oil furnaces and one tempering furnace
Shop blacksmith force	Three operators sharpening, three helpers heating and punching, one blacksmith tempering, and one utility man
Working shift	One 8-hr. shift per day

Dull steels are collected on the various levels underground, brought to the surface and sorted by nippers onto steel cars. These cars consist of trucks on which are mounted four-section bodies, revolving on ball bearings (Fig. 1). By sorting at this point, the blacksmith is saved several miles of walking each day.

The sharpening plant is located aboveground and has three units, each consisting of an oil furnace, Davies air-operated punching machine, Leyner drill sharpener and Davies blow gun.

The steel travels from the dull-steel car in approximately a straight line through each unit to a car for the sharpened steel (Fig. 3). The sequence of operations is as follows: The helper unloads the dull-steel car and places the steel in the furnace; when it comes to the proper heat, he removes it with his right hand, places it in the punching machine, while at the same time his left hand operates a clamping lever, then moves a few inches to the lever that controls the punch—the entire operation is completed in 2 to 3 sec. The hole in the steel is opened for 3 to 4 in. The helper passes the steel to the blacksmith, who receives it in his left hand, places it in the sharpener, bringing the machine into operation with his right hand. After the bit is formed, the steel is reversed and the shank end is placed against the blower; this movement is really a step in transferring from the sharpener to the car. It is desirable to stand the steel with the bit up.

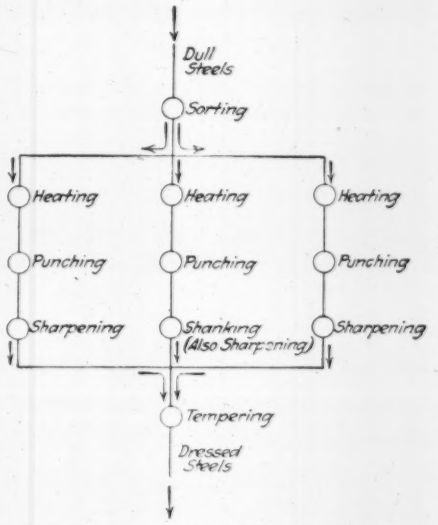

FIG. 3. SEQUENCE OF HANDLING AND SHARPENING OPERATIONS

This method is identical for each sharpening unit, the sharp-steel cars from all traveling to one tempering forge. The steels are then brought to a tempering heat and delivered to the slack tub. Plunge tempering is employed, the bits in water and the shanks in oil.

Between the sharpener and the temperer the steel cools to normal temperature and is ready for reheating. The utility man takes care of grinding and dressing the

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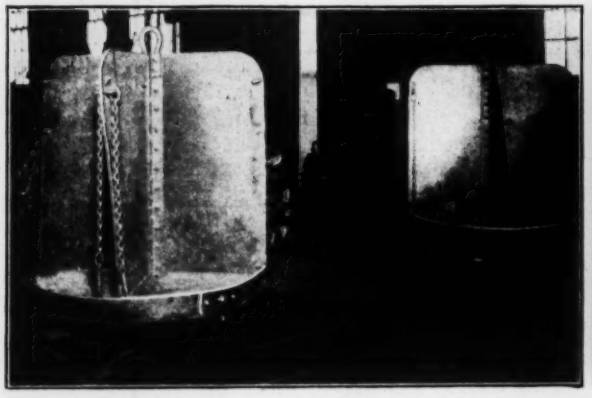
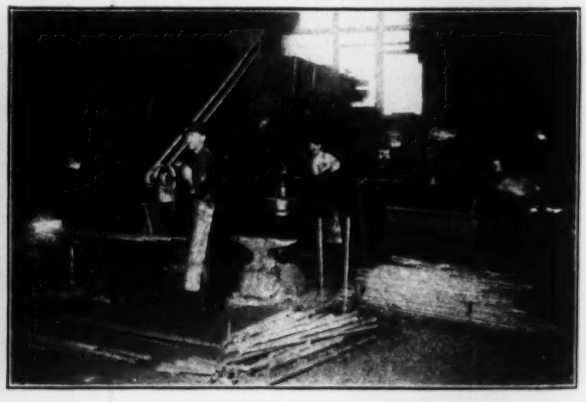




FIGS. 1 AND 2. DRILL-STEEL CARS, AND A DRILL-SHARPENING UNIT

shanks, the No. 3 sharpener being the only one devoted to shanking. Figs. 2 and 4 show the layout of a sharpening unit. The forge is long and low, heating from 15 to 25 steels at one time. The helper starts the steel in the left-hand side of the forge, gradually working it to the

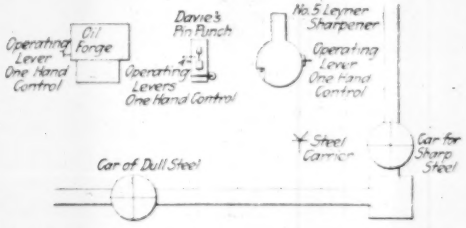


FIG. 4. LAYOUT OF A SHARPENING UNIT

right, each steel thus receiving the proper heat and also bringing it into easy removing position.

The punching machine (Fig. 5) consists of an air plunger governed by an oil cylinder. The piston rod carries a chuck for holding the punches. A self-centering clamp operated by an air cylinder insures alignment of steel and punch. This punch has increased the sharpening capacity 50%.

Each steel is tested by a blow gun. The blacksmith, while turning the steel up to place it on the car, pushes

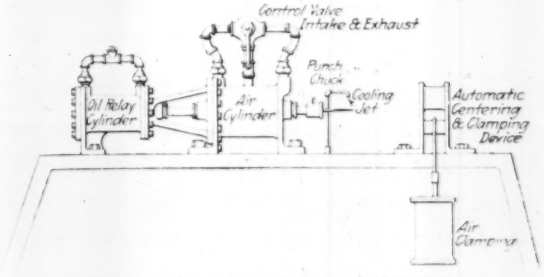


FIG. 5. PUNCH FOR HOLLOW STEELS

the shank against the automatic blow gun. This could be done without reversing the steel, but sparks were sometimes blown upon the operator; and as "Safety First" is one of the mottoes of this shop, the blacksmiths are instructed to test the steel from the shank end. Steel is punched, sharpened and blown out in one heat.

Supervision of drill shanks has resulted in reducing piston and drill-steel breakage. Out of about 5000 pieces used, only two to three are broken per shift.

This paper embodies data furnished by Tom Davies, foreman blacksmith, United Verde Co.

Concrete Road Turnouts Poor Practice

By H. E. Bilger*

For both concrete and brick roads the width of 10 ft. has been found by experience to be the most desirable for a single line of traffic. There have never come to my knowledge conditions that would seem to warrant the construction of these single-track roads with turnouts of the same material provided at convenient places along the line.

Where the concrete road is selected in preference to gravel or macadam, it is usually because of the existence of more or less motor traffic. Considering the desire of the motorist always to be hurrying along and the general failure of legislation to regulate this traffic in rural territory, it is apparent what difficulties would be encountered in attempting not merely to retard, but to stop a motor vehicle long enough to make a turnout for another vehicle to pass.

Rather than use the turnout form of construction it has been considered better to employ for single-track roads the use of continuous gravel or macadam shoulders 3 or 4 ft. wide on each side of the pavement. These shoulders are built only 4 or 5 in. in depth and without sprinkling or rolling, as rolling such narrow widths is impracticable. They consist essentially of a certain amount of gravel or crushed rock placed and leveled off without being carefully worked into a pavement.

Within a comparatively short time the action of traffic and the elements work the material into fairly satisfactory metal shoulders. This form of construction seems practicable and economical, particularly where there can be found along the line of the improvement local materials suitable for the shoulders, although not satisfactory for the concrete pavement.

If it were practicable to keep the speed of motor traffic down to about 20 mi. per hr., the 9-ft. rigid road would be almost as satisfactory as the 10. The fact is, however, that speeds all the way from 20 to 50 mi. per hr. are quite common on concrete and brick roads in rural territory in the prairie states, and to reduce the width below 10 ft. would increase the hazard out of all proportion to the saving afforded by the narrower width.

For types of roads having a less rigidly defined edge than concrete or brick, as gravel, macadam or bituminous macadam, the width can with equal safety be about 1 ft. less than that of the rigid type with only earth or cheaply built metal shoulders.

Under conditions where it is imperative that the initial cost be kept at the absolute minimum I personally would suggest the construction of a 9-ft. concrete road at one side of the center of the graded roadway. There should be at least a 3- or 4-ft. earth shoulder on one side of the concrete and about a 6-ft. gravel or macadam shoulder on the other, with a 3-ft. earth shoulder beyond, thereby providing a graded roadway having a total width of 22 ft.

By this form of construction the earth shoulder first mentioned would serve chiefly as a safety feature, practically never having any traffic and requiring no maintenance other than mowing down the growths. The 6-ft. gravel or macadam shoulder would afford a width sufficient to be constructed properly as a standard road, and it could be maintained more economically than the same square yardage in two 3-ft. strips. It would serve the turnout traffic, as well as favor a much safer motor traffic.

Many miles of 10-ft. concrete and brick roads have been built in Illinois with only an earth shoulder some 6 to 10 ft. wide on each side. The 18-ft. roads are always built with earth shoulders, each usually having a width of from 3 to 6 ft. If at least a 2-ft. shoulder is not built, the outer 12 to 18 in. of the pavement is of no avail for traffic since vehicles cannot travel out to the very edge of the concrete. As earth shoulders are much cheaper per square yard than concrete pavement, I can see no conditions that would warrant the construction of these roads without shoulders unless a raised curb were used.

*Road Engineer, Illinois State Highway Commission, Springfield, Ill.

The Miami Valley Flood-Protection Work

IV—Study of Retarding-Basin Operation

Necessity of Predetermining Frequency and Extent of Basin Flooding; Methods of Calculation of Storage for Known Floods; Flood "Routing" for Past Quarter-Century; Quick Recovery of Basin System; No Summer Flooding

The five great retarding basins of the Miami Conservancy District, though designed with sole regard to their service in the largest possible floods, will also operate in other floods. Moderate floods are relatively frequent; and therefore, though their effects are of less amount, they have a vital bearing on the operating value of the project.

It has been stated, with truth, that a flood little more than half the volume of that of 1913 would do practically the same amount of damage in the Miami Valley cities. A similar statement holds for Columbus, where the Scioto flood of 1916, less than one-third as large as the 1913 flood, came close to the levee tops—and with a little additional volume would have again swept the west side disastrously. Under these conditions the certainty and degree of control which the basins exert on such moderate floods must be known, especially with a view to estimating the relative benefits which different parts of the territory protected only by the retarding basins will receive.

Primary questions on the functioning of the system are such as these: What effect will the basins have on a flood like that of 1913? How large will be the river flow at different points, and where (if anywhere) will the water go out of its banks? How large an area in each of the several basins will be flooded, and how long will water remain on the different parts of this area?

Similar questions asked with respect to floods of a magnitude recurring once in ten years, or once in five years, on the average, are still more important. The answers will determine, for example, what use can be made of the 35,000 acres of good farm land embraced in the basins. If the average annual flood submerges, say, 3000 acres of this territory, and if this is more likely than not to happen in the growing season, then the 3000 acres will be idle land, of little value.

Even questions of strictly engineering character, concerning planning of the works, are involved. In order to compare the cost of different plans of flood control, consideration must be given to the relative losses in land rendered untillable by the frequency of flooding. So also

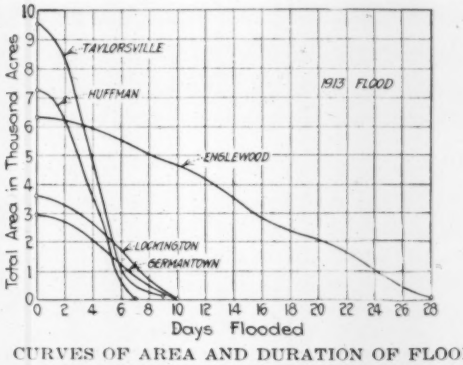
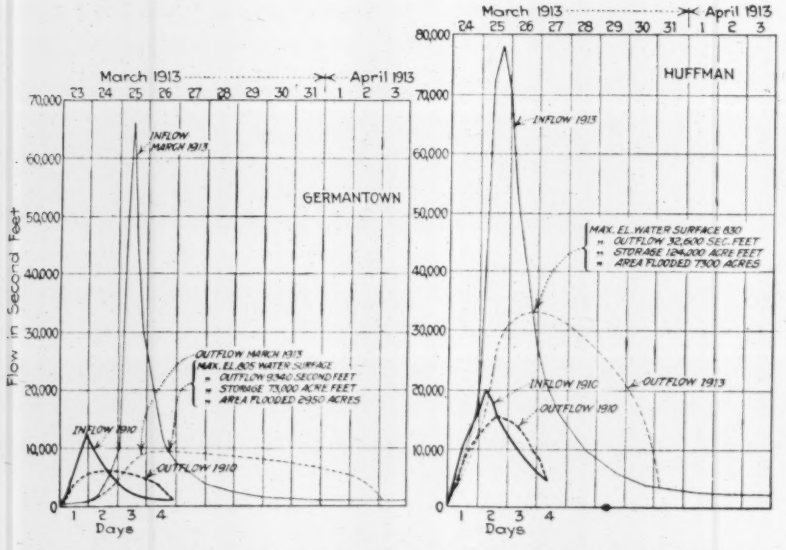


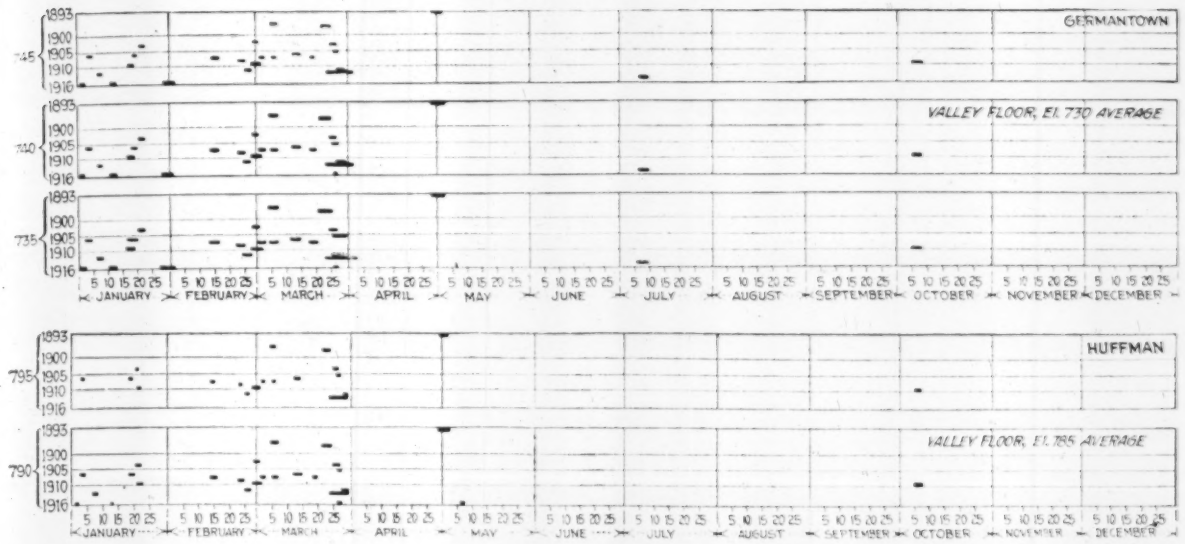
FIG. 3. CURVES OF AREA AND DURATION OF FLOODING IN THE BASINS FOR FLOOD LIKE 1913

the value of a plan will depend partly on the degree of protection from annual floods given to agricultural lands in the valley bottoms below the basins. The height to which ordinary floods will rise in the retarding basins may affect the location and height of drift-catching devices, and may have some influence on the necessity for railway and road relocations. The "recovery" of the flood-control works after a flood—that is, the quickness with which the basins empty themselves and return to normal conditions—is an important factor in defining the security of the system in case of floods in sequence. These questions were answered by a graphical study of basin operation for all the floods whose data are fairly well known. Records were found for all the floods of 24 years, 1893 to 1916, and the study was carried through for each of them. The flow curve of each flood at various points along the river was known, or could be approximated from the data of the river stage records. This curve, for a point at one of the retarding basins, represented the inflow into the basin. In the case of the Taylorsville basin, which is affected by the Lockington basin above, the inflow curve had to be drawn by first finding the Lockington outflow and adding to it the normal (unretarded) flow from that part of the drainage area which lies below Lockington. The rate of outflow from the basin in a flood depends on



FIGS. 1 AND 2. CONTROL CURVES FOR GERMANTOWN AND HUFFMAN RETARDING BASINS FOR 1910 AND 1913 FLOODS

Light lines show flood of March, 1913, heavy lines show flood of October, 1910. The inflow represents the magnitude of the flood without retardation, while the outflow represents the size to which the flood would have been reduced if the retarding basins had been in existence



FIGS. 4 AND 5. TOTAL FLOODING DIAGRAMS FOR 24 YEARS, 1893-1916, HUFFMAN AND GERMANTOWN BASINS

the height to which the basin is flooded. This height in turn depends on the volume stored, which is the difference between the inflow and the outflow. Thus the quantities involved are inter-related. The problem of computing the rate of outflow had to be solved by trial and error.

The calculation was carried out in the form of a tabulation containing in parallel columns the values of inflow rate, outflow rate, storage increment, depth of water and area flooded, for successive time intervals. The inflow was read directly from the flow curve. Assuming then a certain rate of outflow, the difference between inflow and outflow gave the rate of storage, which multiplied by the time interval gave the storage increment. Adding this to the previous storage, if any, gave total storage. There was available a previously computed table for each basin, giving for every foot of storage depth the quantity stored and the area of water surface, all figured from the topographical map of the basin. Using this table, the depth of water which the total storage at the given time would produce was read, and by referring to discharge-rate values calculated from the conduit characteristics the conduit outflow for this depth became known. If the outflow rate so determined checked with the assumed rate of outflow, the computation verified itself.

When these operations had been carried through for the whole series of time intervals covered by the inflow curve, the result was a table of outflow and storage, from which all further questions could be answered.

Basin-Control Curves

Laying off the inflow and outflow rates on a time base to form a time-flow diagram, curves were obtained that show graphically the effect of the basin in controlling (reducing) the particular flood in question, at points immediately below the basin. Such curves are reproduced in Fig. 1 for Germantown basin and in Fig. 2 for Huffman basin. Both diagrams represent two floods out of the 28 of the past 24 years. The March, 1913, flood is shown because of its great magnitude, while the October, 1910, flood is shown as a typical dry-weather flood—one whose effects might be important with respect to farm operations.

It will be seen that the outflow curve reaches a maximum where it intersects the inflow curve. The area between the two curves at the left of the intersection represents the maximum storage. How the basin lowers the flood peak and flattens it out is obvious at first glance. The outflow curve is the reduced river flow below the basin. By adding to it the tributary flow coming into the river at points farther down, a complete picture of the controlled flow is obtained, and it is then possible to make calculations of overflow, required channel enlargement, etc.

Diagrams of Basin Flooding

The table used in plotting the control curve also furnished data for a curve of area of basin lands flooded. Such curves were first plotted on the same time base as the control curve and then, by using the horizontal intercepts of the first curve as abscissas of a second, the relation between area flooded and number of days' duration of flooding was represented graphically.

The duration-of-flooding curves for all five basins for the 1913 flood are grouped in Fig. 3. They bring out the fact that the retarding influence of the basins upon this particular flood ranges from 7 days to 28 days. Englewood basin has by far the longest service, while the other four have nearly equal times of emptying. It is interesting to observe, however, that the two largest of these four basins empty most rapidly, although at peak storage they flood the most land. The relations shown by these curves are not the same for different floods, however. A single diagram like Fig. 3 is therefore not a safe basis for generalizations.

The area-time curve, from which the duration-of-flooding diagram was derived, furnished the data also for an important chart quite different in character. This is the frequency-of-flooding diagram, or, as it was named from its appearance, the pianola diagram (Figs. 4 and 5).

Frequency of Flooding During Past 24 Years

Nearly 40,000 acres of land, of which a large part is excellent farming land, lie back of the dams below their spillway levels. This land is worth probably from $3,000,000 to $5,000,000, and its annual producing power may be placed conservatively at $500,000. The Miami region ought not to be deprived of this large producing territory or needlessly taxed by so large an annual loss. There was much apprehension in the valley over the effects of the

flood-control project in laying idle these agricultural areas, and it became an important issue in the prolonged Conservancy Court hearing on adoption of the plan.

The Conservancy District intends to buy outright as much of the basin lands below spillway level as may be necessary, in order to eliminate questions over continued occupancy, as well as dispute and litigation over the value of basin easements. However, this does not reduce the necessity for preserving as much as possible of the productive value of the basin lands.

By charting the frequency of flooding in the most comprehensive manner that could be devised a remarkable and in all respects reassuring picture of basin conditions was secured. Figs. 4 and 5 reproduce the charts for Germantown and Huffman basins, the one typifying the basin with relatively small outlets, the other the basin with large outlets (Taylorsville and Huffman). Only the lower stages are covered by the reproduced charts, although the originals were carried up to the maximum storage.

There were only four dry-season floods during the entire 24 years; the fourth is barely visible in the lowest line of the Germantown chart, Fig. 4. During the entire period only two floods occurring in the early growing season would have submerged any material part of the valley bottom. Since these two include the 1913 flood, whose probable mean recurrence interval has been estimated as more than 150 years, the frequency of flooding is even less than the chart indicates. The lowest basin lands will not be submerged on the average oftener than once in 15 years during the months of April to September inclusive. At the higher elevations the flood effects decrease rapidly.

The relatively frequent winter and spring flooding is expected to have no effect on agricultural use of the land, or, if any, a beneficial effect. The opinions of experts and experience in the frequently flooded bottoms near the mouth of the Miami joined in showing that winter or spring flooding is likely to increase the fertility of the land. For this reason the middle portion of the charts, covering the growing months, is most significant.

The Basin-Recovery Curve; Floods in Sequence

To determine how soon after a flood the basins would again be in normal condition it is sufficient to refer to the control curves, such as Figs. 1 and 2, from which the time when the control ceases—that is, when storage is discharged—can be read. But the amounts of storage capacity available at various times before the complete emptying are not evident. To show these amounts the curves represented by Fig. 6 were drawn.

These curves, derived from the data given by the control tabulations, show percentage of basin capacity left empty at varying periods of time after peak of flood. Fig. 6 is for the Huffman basin and the 1913 flood, the largest on record. Even at peak storage about 25% of the spillway-level capacity would remain empty. Two days later no less than 60% of the basin capacity would be available to receive a following flood, and in four days after peak stage the entire capacity would be available.

This study is important mainly because so little experience is at hand concerning the possibility of two flood storms occurring in quick succession. Conceding such possibility for storms less than that of 1913, the duplication of a 1913 storm within a week appears quite impossible. Yet, the curves show, even in such a case the system is safe (and that without trenching on the reserve capacity, above spillway level). In addition, the recovery curves have bearing indirectly on the question of basins functioning in a storm of more than three days' duration.

To summarize in brief a few of the results of the basin study, the following approximate statements may be made: Ordinary summer floods will go through the two large basins (Taylorsville and Huffman) without even filling the conduits and with but momentary wetting of the low bottoms close behind the dams (not over 200 to 400 acres). In the other three basins the summer floods will produce material storage. It follows that ordinary

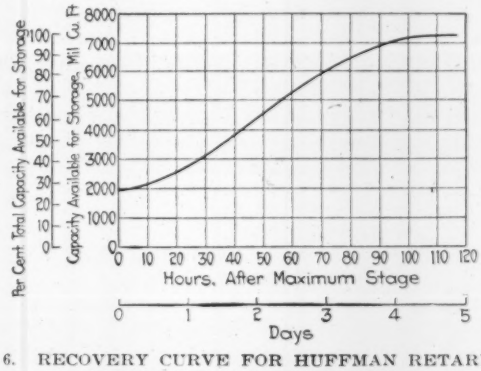


FIG. 6. RECOVERY CURVE FOR HUFFMAN RETARDING BASIN (FOR FLOOD LIKE 1913)

small floods are subjected to but little control at Huffman and Taylorsville.

The average five-year flood (fairly well represented by the 1910 flood, see Figs. 1 and 2) will produce considerable storage in all the basins and therefore will be reduced in stage throughout the valley. The average 25-year flood will be reduced very materially by basin retardation. For both the 5- and the 25-year floods, therefore, farm lands in the valley below, where no channel enlargement is done, will derive benefit from the Conservancy works, while they will get little or no protection against the normal annual flood.

Kenneth C. Grant had charge of studies of action of retarding basins during floods and directed the preparation of practically all the tables and diagrams referred to in this article; A. B. Mayhew made numerous studies of balancing various reservoirs in a harmonious system; Barton M. Jones developed general methods for determining requisite spillway capacities for any set of conditions.

In the article "Dams and Outlet Problems," the third article of the series, printed last week, the following should be *substituted* for the last paragraph:

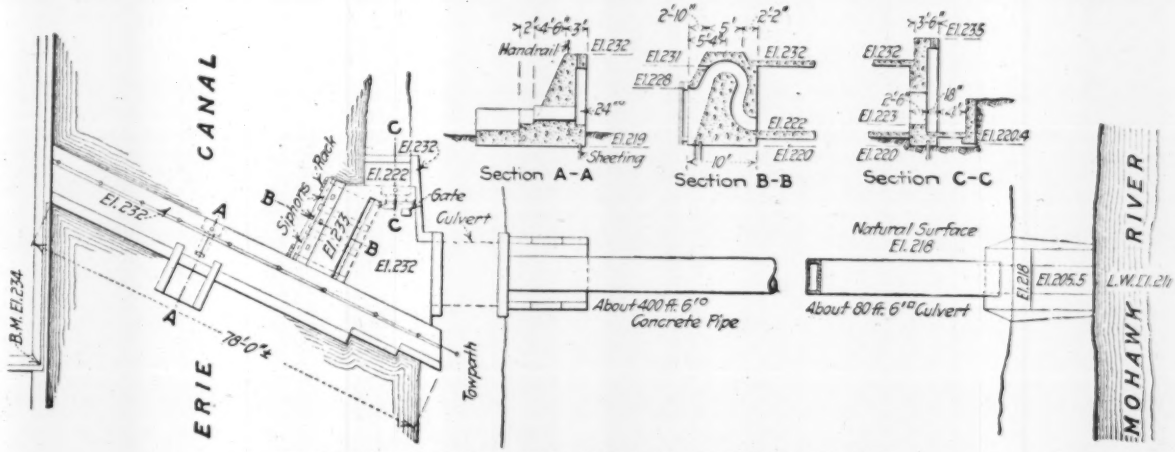
A considerable number of engineers exercised independent responsibility in working out the details of different portions of the designs. The final results were brought together under the general supervision of Charles H. Paul, Assistant Chief Engineer, and S. M. Woodward, Consulting Engineer. J. S. Kimball had charge of channel improvements throughout the ten cities and towns involved. Walter M. Smith, Designing Engineer, had charge of design of dams and related structures. R. M. Riegel worked out the experimental investigation of the hydraulic jump and the details of design of the combined outlet conduits and spillways. O. N. Floyd had charge of plans for railroad relocations and changes to other public utilities. H. S. R. McCurdy made studies of subsurface conditions and conducted investigations and tests of materials available for foundations, embankments, etc.

Siphon Spillway at Schenectady

By Ralph B. Allen*

An interesting siphon spillway for automatic water-level control has recently been completed for the General Electric Co., at Schenectady, N. Y. These spillways are located, as shown by the accompanying sketch, at a dam that has been built across the old Erie Canal, adjacent to the General Electric property, the impounded waters to be used for condensers for that company.

After several studies of different types of overflow spillways it was determined that siphons would be more efficient and economical, and that better results would be obtained as the opening to a discharge pipe line, which was necessary, would be entirely covered so that no refuse could enter. On the other hand, an overflow spillway of the required capacity would necessitate a prohibitive length and would necessarily have to be uncovered.



SELF-PRIMING SIPHON SPILLWAYS AT SCHENECTADY, N. Y.

The top of the dam is at El. 232. The water surface above is to be maintained at El. 231, with very little fluctuation. This is accomplished automatically by the three-siphon spillway, each siphon having a capacity of about 80. cu.ft. per sec. at time of high water in the Mohawk River, when the minimum siphon head will be 4 ft.

The section of each siphon spillway required for the necessary capacity is shown in the accompanying sketch by the section B-B, each of the three siphons being built in the masonry and having a crown section of 4 ft. wide by 1 ft. 9 in. deep. Partition walls 1 ft. thick divide the siphons. As will be noted, the intake opening is placed well below the water surface to avoid the entrance of ice or débris, and is further protected by a timber screen. The discharge end is constructed as low as possible in order to obtain all available head. The crown is built above the required water level.

The siphon is controlled by the 4x9-in. vent, which is located slightly below the required water stage. As the water above the dam rises and submerges the vent, so that no air may enter the siphon, the water spills over the crown and with this overflow the air is carried out. As the air becomes rarefied in the siphon, the water rises higher in the crown than the water surface above the dam. The crown becomes completely filled almost as soon as overflow occurs. This primes the siphon, siphonic action takes place, and a rapid flow commences. This flow continues until the water surface is drawn down to below the vent; and when a sufficient quantity of air is admitted, the siphon breaks. The break is not complete at the instant of the entrance of air, but is gradual, as the admission of a small quantity of air simply decreases the flow.

When this siphon was completed, the theory of self-priming was entirely borne out (as it had been before at the Champlain Canal siphon spillways and earlier in Europe[1]); action took place almost the moment the vents were submerged, and ceased when the water was drawn down to the proper elevation.

The water drawn above the dam by the siphons is discharged through a 5-ft. reinforced-concrete conduit, under a small head, to the Mohawk River. A 24-in. gate valve was installed in the dam at a low elevation, to allow for necessary flow to avoid stagnation below the dam. A rectangular gate, 54x54 in., was also placed in line with the spillways to discharge directly into the pipe line to permit the complete drawing down of the water.

As will be noted from the sketch, the elevation of the control vents for each unit is slightly higher than the preceding unit, thereby allowing a more constant regulation of the water level. Siphon No. 1 will prime and discharge about 80 sec.-ft. almost immediately when the water closes the first vent; a rise of 0.1 ft. will prime siphon No. 2, etc., the required flow depending on the number of condensing units in use. At present there is but one condenser installed, but two additional are contemplated in the near future, each requiring 70 sec.-ft. The water surface is thereby absolutely automatically maintained.

The dam and siphons are founded on clay with sheet-piling cutoff. The pipe line is principally of "Lock-Joint" reinforced-concrete pipe, having a 5-ft. inside diameter and 6-in. thickness, and also a stretch of about 80 ft. of 5-ft. square reinforced culvert ending in a head wall, the discharge end of the pipe being placed below the low-water level of the Mohawk River, to eliminate trouble from ice or refuse.

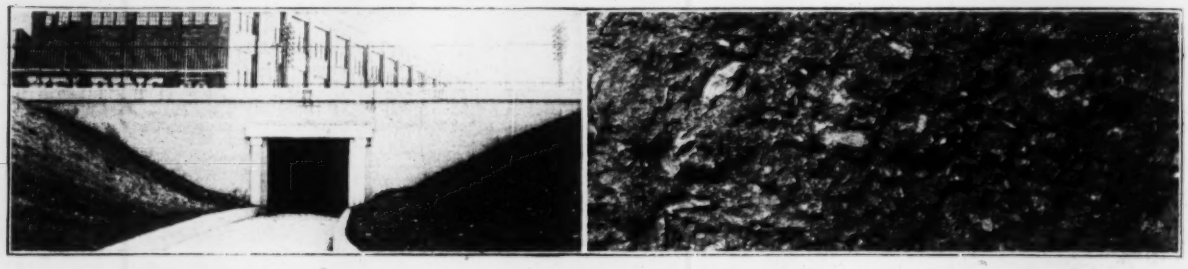
The entire structure was designed by William Russell Davis, Consulting Engineer, Albany, N. Y., for the General Electric Co. The siphon spillway used is patented by George F. Stickney, Albany, N. Y. (designer of the Champlain Canal siphons, the first built in America).

*Assistant to William Russell Davis, Consulting Engineer, 311 Arkay Building, Albany, N. Y.

[1]See "Engineering News," Oct. 30, 1910, and Apr. 20, 1911.

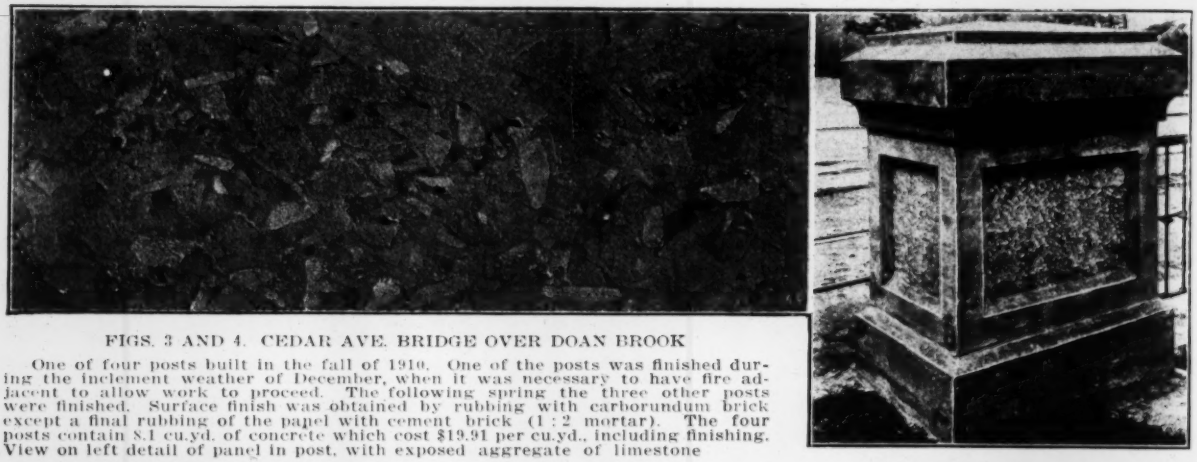
Concrete Finish on Some Cleveland Bridges

On this and the following page are shown recent views of some reinforced-concrete bridges at Cleveland, Ohio, in which special effort was made to obtain pleasing texture and line in the concrete surfaces. In each case a distant view is given of the structure or a part of it and this is accompanied by one or two close-up views showing the detail texture. In addition under each set of views is a description of the structure and of the method followed in the surface finishing. In some of the bridges, also, the cost of this finishing is given. Particular attention might be called to the accentuation of shadow in the details of some of the structures, especially in those shown in Figs. 11 to 15, with the accompanying improvement in appearance over the ornamentation or fine detail decoration somewhat common in concrete bridges, especially in those of monumental type.



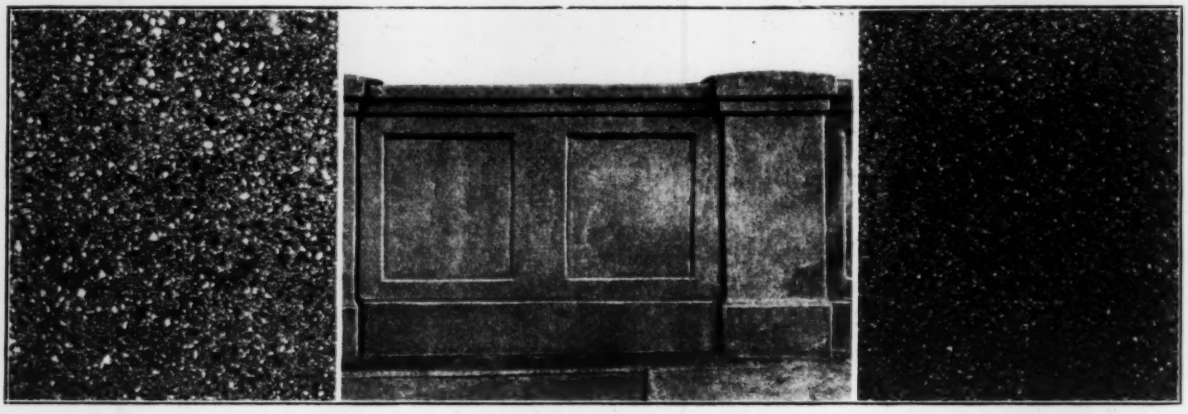
FIGS. 1 AND 2. TUNNEL FOR FOOT PASSENGERS UNDER RAILWAY AT EDGEWATER PARK

Under New York Central R.R. at foot of West 76th St. Side walls were bush-hammered as soon as forms could be removed; that is, from 20 to 30 days after placing concrete. Hammer weighed 5 to 6 lb., had 2½-in. square face, 9 teeth on one end, 16 teeth on other. The 9-tooth face used for roughing and 16-tooth face for finishing. At right is close-up view of bush-hammered surface on the main side wall shown



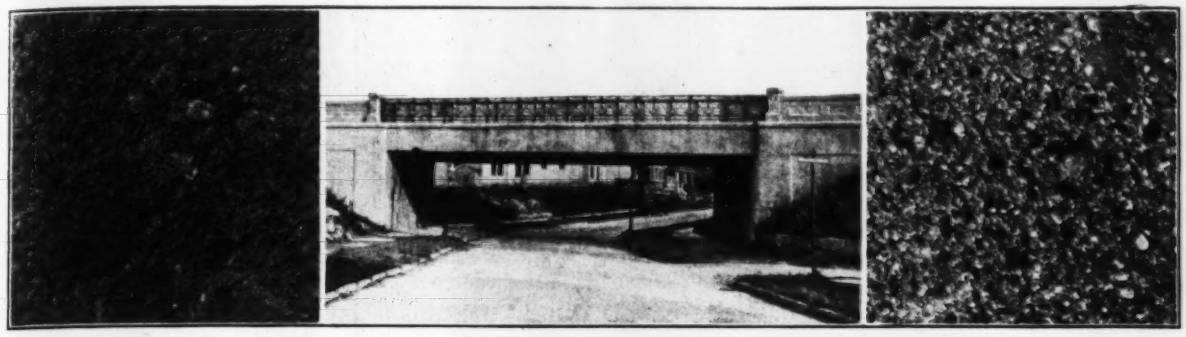
FIGS. 3 AND 4. CEDAR AVE. BRIDGE OVER DOAN BROOK

One of four posts built in the fall of 1910. One of the posts was finished during the inclement weather of December, when it was necessary to have fire adjacent to allow work to proceed. The following spring the three other posts were finished. Surface finish was obtained by rubbing with carborundum brick except a final rubbing of the panel with cement brick (1 : 2 mortar). The four posts contain 8.1 cu.yd. of concrete which cost $19.91 per cu.yd., including finishing. View on left detail of panel in post, with exposed aggregate of limestone



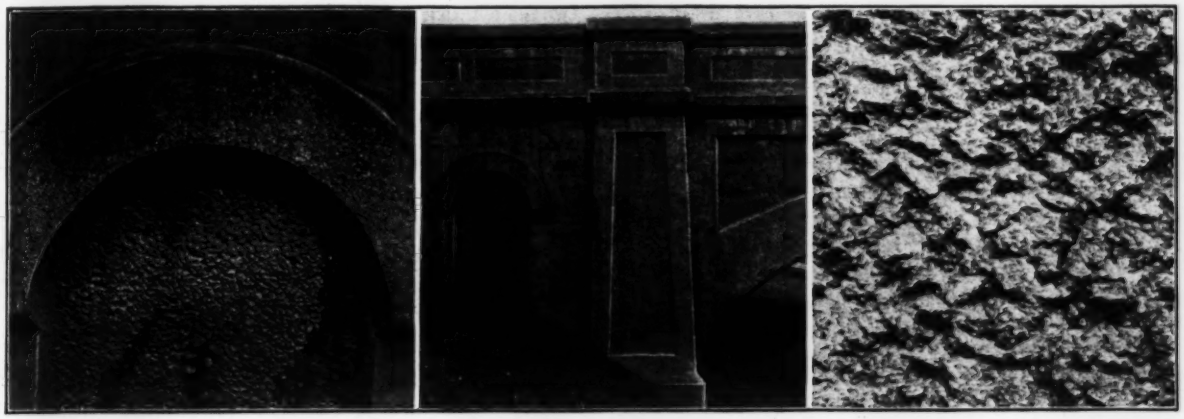
FIGS. 5 TO 7. FAIRMOUNT ROAD BRIDGE OVER FOUR-TRACK RAILWAY LINE

Reinforced-concrete railing on structural steel bridge incased in concrete. Aggregate of railing is screened gravel 1 : 2 : 4, which was bush-hammered with pneumatic tools. Mortar (1 : 2) then was applied and rubbed to finish with wood floats. Work was completed in November, 1912. Pneumatic bush-hammering cost $0.1175 per sq.ft. without overhead. Cost of mortar coat was not kept separate from other items of surface finish. The appearance of the surface finish is excellent and shows no signs of deterioration. View on left is detail of coarse sand finish and on right of fine sand finish



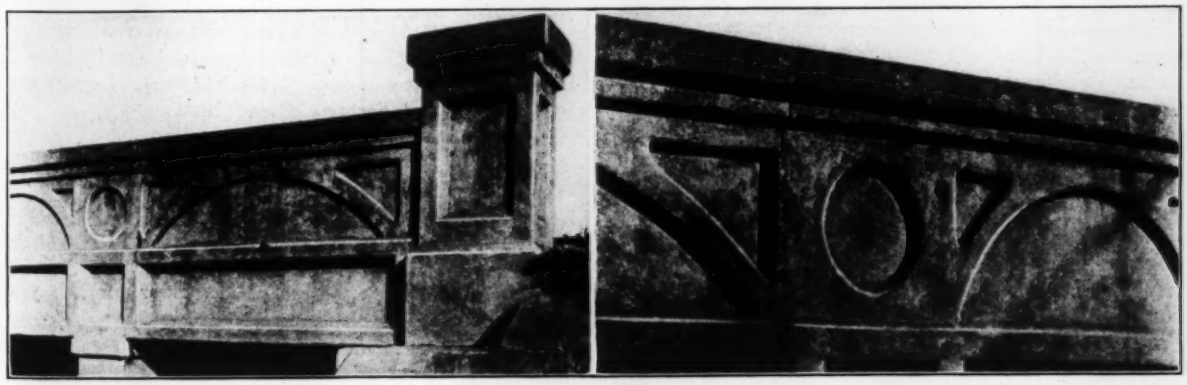
FIGS. 8 TO 10. SHAW AVE. BRIDGE CARRYING TWO-TRACK RAILWAY

Bridge is through plate-girder with floor incased in concrete and girders hidden from street. View on right is an enlarged detail of the bush-hammered surface of the railing, which is 1 : 2 : 4 concrete with screened gravel as the aggregate. View on left is of the panel in the wing finished by bush-hammering with air tools. The concrete is a 1: 3: 6 sand and limestone, in which the larger stones were spaded back from the face. Work was completed in September, 1912. There were 3420 sq.ft. of surface bush-hammered at a cost of $0.0621 per sq.ft.



FIGS. 11 TO 13. EAST BOULEVARD BRIDGE CARRYING TWO RAILWAY TRACKS

The matrix of the arch over the bay of the belt courses and in the panels is crushed red granite from Pictou Island in the St. Lawrence River. Screenings made by the crusher in preparing coarse aggregate for panels were used in belt courses and arches over bays. The surface finish was about 2 in. thick, mortar of which was colored with iron oxide. All surfaces were bush-hammered except the panels where the aggregate was exposed by picking out the mortar with pneumatic tools. View on right is detail of this surface. It was the intention to expose the aggregate in the bays by use of brushes, but sudden coming of cold weather rendered postponement necessary. Smooth-rubbed surfaces were obtained by applying 1 : 2 mortar to the bush-hammered surfaces, then rubbing with carborundum brick. The appearance of this structure is more pleasing than when finished in October, 1912. When just finished, the smooth surfaces were a light pink, but with weathering contrast in color has disappeared. View on left is detail of decorative archway



FIGS. 14 AND 15. MAYFIELD ROAD BRIDGE CARRYING FOUR RAILWAY TRACKS

Structural steel bridge, through plate girders between curbs. View on right a detail of portion of facia. The concrete, a 1 : 2 : 4 mixture in which screened gravel was the aggregate, was applied directly upon the outer girder. The entire surface was bush-hammered with pneumatic tools after the concrete had become thoroughly hard. Sand finish was applied same as on Fairmount Road (Figs. 5 to 7). The area bush-hammered was 8280 sq.ft. and cost $0.1084 per sq.ft. Cost to apply mortar coat was not kept separate from other items of finishing. Work was completed in 1912 and is in as good condition as when finished. Note good shadow effects in detail

Early Experience with Concrete Paving

Last year, the Portland Cement Association estimates, nearly 25,000,000 sq.yd. of concrete street, road and alley pavement was constructed in this country—equivalent to almost 2500 mi. of 18-ft. road. This is nearly three-quarters of the total amount of concrete pavement laid previous to Jan. 1, 1916, which brings home how new this branch of the paving industry is and what great strides it has made in the last two or three years.

Few realize that concrete paving has a history of nearly half a century, and that its present success is in no small measure due to the same changing traffic conditions which have thrown waterbound macadam into the discard. For it is unlikely that concrete paving would ever have been developed to its present popularity had traffic remained chiefly of the horse-drawn variety.

Knowing that portland cement concrete has been used for pavement foundations since about the middle of the last century, one's curiosity is aroused to know if it was not at some early date proposed for pavement surfacing, and why it was so long coming to its own.

Early English Concrete Roads

The original source of much of our present literature on pavements is a lengthy discussion before the Institution of Civil Engineers in April, 1879, on "Street Carriageway Pavements." At that time wood-block and sheet-asphalt pavements were coming into extensive use and the improvement of stone-block pavements by use of concrete foundations was regularly practiced in London and the other great cities of Europe.

Discussing concrete as the suitable foundation for wood-block pavement, Joseph Mitchell, of Inverness, said that he "was convinced that for secondary streets concrete alone, if properly laid, would make a perfect and durable road; but with the cement hardening so quickly, it required careful manipulation.[1] Mitchell had previously patented (1865) a two-course concrete pavement of a 1:1½:4 mix, which probably was one reason for its not being more widely adopted at that time.

Another reason against its adoption very likely was that these early experiments proved unsatisfactory because of the inability of the concrete to withstand the abrasion of heavy horse-drawn traffic. Another engineer, J. Price, had this in mind during the same discussion when he described a type of concrete pavement which he had developed and used to a small extent. In this present day of widespread use of concrete paving, Price's early experiment may still contain a helpful suggestion.

His pavement consisted of a thick bed of portland cement concrete. While still in a soft state it was paved on top with angular pieces of granite, or other hard stone, set with the flattest face upward, fitted into each other at random. This he called a "breccia" pavement from the geological term for angular conglomerate. It possessed the bearing strength of concrete with the abrasive resistance of the granite. The concrete filled the irregular interstices between and around the stones and formed a solid mass. The method of construction was to board off a section of concrete and before it hardened workmen placed the stones and bedded them by hand, working from a bridge.

[1]Minutes of Proceedings of Institution of Civil Engineers, 1879.

Following these isolated early experiments, most of the development in concrete pavement seems to have taken place in the United States. The first use of concrete for paving here was for sidewalks, then for alley pavements, and in 1892 a strip of concrete 10 ft. wide and about 200 ft. long was laid on the west side of Main St. in Bellefontaine, Ohio, being so far as known the first portland cement concrete street pavement in this country. It appears, however, from an article by G. W. Bartholomew, Jr., in *Engineering News*, Jan. 3, 1895, that a concrete pavement was laid in Detroit, Mich., about the same time.

Bellefontaine Has Early Pavement

Much has been made of the fact that the Bellefontaine pavements are still in existence and in fair condition, but it seems that they were model construction in their day. The subsoil is gravel and a 4-in. tile drain was placed under each curb. The pavement was made in two courses, the lower 4 in. being 1:4 cement and gravel, the ratio of the gravel or stone to the sand being 2:1, or the mix was 1:1⅓:2⅔, which it will be seen is a richer mixture than commonly used today. The top 2 in. was a 1:1 mix, cement and sand or crushed granite to the size of a pea. The pavement was divided into 5-ft. slabs by tar paper joints, the idea being to make the subsurface structures more accessible than with a monolithic pavement. These pavements cost $2.15 per sq.yd., including curbs and tile drains.

The Bellefontaine pavements were inspected in March, 1903, by Prof. F. H. Eno, of Ohio State University, who described them in *Engineering News*, Jan. 7, 1904. He wrote that on the main streets where traffic was distributed there were few signs of deterioration and no cracks of any account, but that on the narrow streets wheel ruts had been worn in the longitudinal joints, as some photographs which went with his article show. The surface was originally rolled with a metal imprint roller in order to give a foothold for horses, but at the end of 10 years these had in most instances entirely worn off.

Following the success of the pavements in Bellefontaine other Middle West cities tried them and concrete became a recognized type of city pavement, although never extensively used until within the last 10 years. Among some of the Middle West towns and cities which have concrete pavements 15 or more years old are Richmond, Ind. (1896), Kalamazoo, Mich. (1896), Logansport, Ind. (1900), and Fostoria, Ohio (1902).

Rochester Pavement Built 25 Years Ago

In 1893 J. Y. McClintock, then City Surveyor of Rochester, N. Y., did some experimenting with concrete as a surfacing for macadam which was then beginning to wear out. The following is an extract from the printed report of the City Surveyor of Rochester for the year ending Apr. 1, 1894:

CONCRETE PAVEMENT—There are many miles of streets where a cheap pavement is requisite and where macadam with trap rock would be suitable except that it seems desirable to get rid of the small amount of mud which is usually present and to have a surface that can be washed clean. To meet this requirement we tried the following pavement on South Fitzhugh St., north of the canal in 1893. The surface of an existing macadam pavement was picked off and a layer of trap rock 6 in. thick in the middle and 2 in. thick at edge of the paved gutters was put on and thoroughly rolled with a

team roller. After this was done, instead of putting on a binding material and rolling that in as usual, portland cement grout, one of sand to one of cement, mixed to the consistency of cream was carefully poured in, so as to fill all the voids between the broken stone and form a solid matrix to hold each stone firmly in position. The stone was thoroughly wet just before pouring in the grout. One barrel of cement was used to each 8.7 sq.yd. of pavement. After the mortar had set for 24 hr., sand was thrown over the surface and water was sprinkled upon it, and all travel was kept off it for nine days. This has been down eight months and already shows that the size of stone used was too small; it would all pass through a 1½-in. ring. The stones are so small that the calk of a horse's shoe sometimes throws out a stone bodily. I believe it will be well to try this again with stones which will pass a 3-in. ring and will not pass a 2-in. ring. The cost of this pavement was $1 per sq.yd.

Mr. McClintock gives a further record of this pavement in a letter to the editor as follows:

As far as I know, the proposition originated with myself. The impelling consideration came from the fact that I had recently become City Surveyor and macadam pavements had become so unpopular that it required a vote of 15 out of 16 aldermen to pass an ordinance for such a pavement in the City of Rochester, because many miles had been built with soft local stone which would usually wear out so as to be scraped off by the Highway Department the year following construction. I was familiar with what was being accomplished in New Jersey and Massachusetts in the use of trap rock and so making a successful macadam road. Being familiar with the use of cement and being impressed by the possibilities of using portland cement which then had first been reduced to a price warranting its use in highway construction, it was very natural that I should try it as described. I made a communication to the Board of Aldermen, discussing the subject and emphasizing the importance of trying it, and asking them to allow me to try it experimentally in the manner described.

The piece of pavement laid developed irregular temperature cracks and on one portion of it, where the hacks stood in the shade of the court house, the horses would drill holes with their feet in kicking off flies, so that it soon became a question of how the pavement could be maintained. It was some two and a half years after the pavement was laid, when I left the office of City Engineer, as it had then become; and as I understand it, some two years after that—when an overhead bridge crossing the canal in the vicinity of the pavement was replaced by a lift bridge and the approaching grades were reduced—it was deemed wise by the city authorities to cover the new portion of roadway with asphalt, and at that time they also pulled out this short section of concrete and substituted asphalt.

Advisability of Using Old Macadam as a Pavement Foundation

By W. S. Anderson*

Engineers in considering the problem of rebuilding an old macadam roadway with a permanent surface generally insist (although it is not always secured) upon a subgrade of uniform density. To accomplish this, when the width of the new roadway exceeds the width of the old macadam road, is difficult without the expenditure of a considerable sum and causing inconvenience at times to the traveling public. What plan of procedure, then, is most logical?

First, it must be granted that if the subgrade adjusts itself to any extent in any manner whatsoever or if the center of the roadway is well compacted and the sides are less dense, cracks will occur in the pavement surface regardless of the type of pavement or kind of material used. To eliminate cracks, the subgrade must be made uniform in character by scarifying and loosening the old macadam foundation and by a uniform respreading and rolling of the excavated material over the subgrade.

Such a procedure does not necessarily insure a uniformly compacted subgrade, but approaches it within practical limits. Its accomplishment will cost considerable money, amounting approximately to from $800 to $1500 per mi. when the surface profile of the new road is made parallel to that of the old macadam road or when cuts or fills do not exceed about one or two feet.

Merely to remove the crown of the old macadam road and to spread and roll this material over the full new width would reduce this cost approximately 70%, which saving could be used to maintain the cracks that might subsequently occur in the pavement.

Is it wise to allow such an argument to sway one's judgment in the establishment of a uniform plan of procedure? It is not, for the simple reason that conditions such as depth of foundation, degree of compactness, and others as well, vary so greatly on each particular job that a definite recipe for all cases cannot be suggested.

Each job must of necessity be studied separately, with the one idea in view of building the best pavement possible commensurate with obtaining the largest mileage for the money available. When the cost of scarifying or loosening the macadam foundation is not too great a proportion of the total cost of the pavement proper, such precautions should be taken. By so doing, a large number of the cracks that would otherwise occur will be eliminated.

In addition to cost, the question of convenience to the traveling public is all-important. If the road in question is urgently needed by the public and if its use during part of the construction period would be of financial value and of convenience to the community, the plan of not scarifying or removing the macadam foundation deserves consideration. If the foundation is removed or destroyed, the old road will be unfit for travel during the period of construction, and ruts and ridges will be produced by the vehicles.

Ruts in subgrades are of considerable detriment to its uniformity in that each rut becomes more compact than the material adjoining and is then later filled with less compacted material that will act as a small individual reservoir for subsurface water. Under such conditions it would be more feasible and valuable to construct the permanent pavement on the old macadam surface with merely its crown removed, the excess material being spread over and rolled in the sides. In conclusion, these thoughts can be summarized as follows:

1. Each job must be studied by itself, and its relation to public service must be given consideration.

2. The economy realized by not destroying the macadam foundation should be weighed against the disadvantages of cracking and disintegration of the pavement surface.

3. The cost and feasibility of maintaining the cracks that may occur in the particular pavement in question must be known or determined within practical limits.

4. When side fills of more than one foot in depth are required to obtain the new road width, the macadam foundation should in all cases be loosened or scarified to a depth of not less than one foot and the material spread uniformly over the entire width of the subgrade.

*Assistant Division Engineer, Promotion Bureau, Universal Portland Cement Co., Chicago, Ill.

Sewage Treatment as Seen by the Layman is illustrated in a ludicrous manner in a Chicago paper whose staff correspondent, reporting a visit to the experimental sewage-treatment plant at Decatur, Ill., says: "The sewage flows in at one end of this machine and comes out at the other end divided into grease, ammonia, potash, fertilizer and water."

New Skylight Design for Trainshed at Lackawanna Station, Buffalo

By A. E. Deal*

After several years of continual annoyance with wire-glass skylights on various railroad structures, principally on the Hoboken and Scranton trainsheds of the Bush type, the Lackawanna R.R. determined to avoid, if possible, the recurrence of the trouble on the new Buffalo trainshed. Skylights for a Bush shed must be built in a nearly horizontal position. Whether the difficulty in withstanding the conditions is due to the glass being insufficiently supported or whether glass will naturally crack as a result of internal stresses when laid horizontally in spans of 5 or 6 ft., the fact remains that the old type is not satisfactory, both on account of the leakage through the cracked glass and of its general unsightly appearance resulting from deposition of sediment from locomotive smoke. These skylights cannot be cleaned, because the construction is not strong enough to stand it. The cost of repairs is altogether too much. There is about 90,000 sq.ft. of skylights in the Hoboken trainshed, built in 1905, which must be replaced in a few years.

When the question of the Buffalo trainshed skylights arose, specifications were drawn for the old metal wire-glass type. This specification avoided having any steel exposed to the weather; that is, the steel had to be lead coated or monel metal sections, and further, the flashings specified were to be of monel metal, which is practically weatherproof. Bids were secured, and it was found that this unsatisfactory type would cost at least 50% more than the concrete type.

The reinforced-concrete construction was therefore decided upon, using small glass squares (6 or 7 in.), which is merely an adaption of the concrete vault-light construction employed frequently for lighting beneath sidewalks. The idea of applying this construction to skylights was adopted for the Kansas City Terminal Ry. trainshed. Several of the manufacturers of concrete skylights have a product in which part of the reinforcing steel is exposed to the air. Those types were eliminated from consideration, and three quite different styles of comparatively the same cost were selected for investigation. The railroad had sample slabs constructed by the manufacturers and fully tested at Columbia University for strength and lighting efficiency. On a 5-ft. span one type carried an equivalent uniform load of 2058 lb. per sq.ft., while the one selected produced 649 lb. per sq.ft.

The trainshed that was designed and that has since been built is shown in the accompanying drawings. It consists of arched girders spanning two tracks and carrying continuous reinforced-concrete roof slabs that are opened over the tracks for the smoke-vent trough and over the platforms and the midtrack space to carry glass-panel skylights. The platform lights have a single slope and, as shown in Fig. 2, are in sections 22 ft. 8⅛ in. long, spanning the adjacent arches and 5 ft. 11 in. wide spanning the concrete structure of the opening. Each section is in separated panels, made up of forty 6⅛-in. square glass lights. The midtrack section is similar in design, but has a double slope to fit the peak of the roof.

The concrete in the skylight is mixed in the proportion of one part cement to two of sand, no coarse aggregate being used. The lower half of the slab up to the seat for the glass is precast in the shop of the manufacturer; after setting up, it is shipped to the site, the glass units set in place, and finally the upper half of the slab is concreted. The precasting in the shop permits using molds cheaply and eliminating falsework in the field. The reason for not casting it entirely in the shop is to provide for the copper expansion strip that is embedded in the concrete.

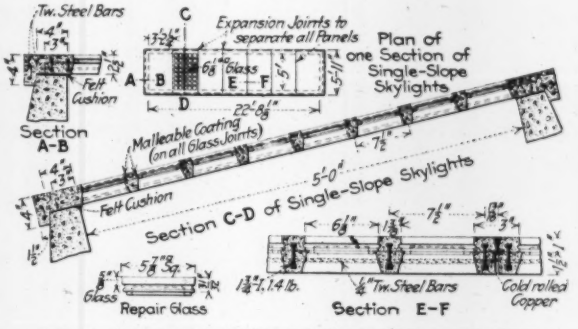


FIG. 2. DETAILS OF THE ONE SLOPE SKYLIGHT IN TRAINSHED

It is considered most important to keep the skylight well above the roof on top of the concrete curbs, so that after a heavy snowfall the skylight will not be covered with snow and slush.

Other salient features requisite to good construction are the facility to replace a broken unit, the proper annealing of the glass and the general neatness of appearance. Units of glass will get broken accidentally, necessitating a convenient method of replacement without injuring the adjacent concrete and without sacrificing its water-tightness. In the adopted type this is accomplished by carefully knocking out the glass, including the encircling convex rib. The glass unit used in replacing is slightly smaller in size and has a groove around its sides. This groove, together with the one left in the concrete by the original unit, is filled with neat cement and the glass forced into position.

To provide against shaling of the glass or chipping of the concrete due to the unequal expansions, the surface of the glass in contact with the concrete is coated with

*Bridge Engineer, Delaware, Lackawanna & Western R.R., Hoboken, N. J.

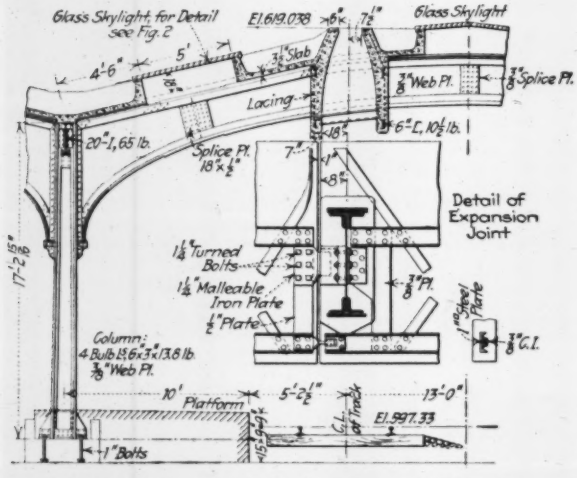


FIG. 1. HALF-SECTION THROUGH TYPICAL TRAINSHED BAY

plastic cement. In order to avoid internal strains usually inherent and which in time will disintegrate the glass, it was specified that the glass should be thoroughly annealed and allowed to cool 36 hr. in a sealed oven. The strains in the glass are readily detected by the use of the sleroscope; and when strains are present, the glass must be reannealed. Each glass unit is inspected by the manufacturer, and the railroad's inspector checks his work by selecting units at random.

In the illumination tests, which were obtained by the use of a photometer, an interesting and unexpected feature developed in that a plain glass surface permitted better transfusion and more diffusion of light than either a fresnel lens or ornamental under-surface.

The manufacturer and patentee is the American Bar Lock Co., which is guaranteeing the work under bond for five years. The design was made in the office of the writer, under the direction of George J. Ray, Chief Engineer of the Delaware, Lackawanna & Western R.R.

Drafting Room vs. Shop*

Many good machinists secretly believe that they can make drawings the equal of those turned out by the best draftsman that ever strutted through a machine shop—with a little practice. This belief is natural; in many cases it is a just belief. In many cases, though, it is a belief based upon an erroneous idea of what constitutes a draftsman and the nature of his work. "Why," I have heard machinists say, "all a feller needs is a little practice twirling a compass, a little brushing up on arithmetic, and the chance!" Sure! And the most difficult of these is the chance. There is more truth than wisdom in this; but also, there is more to drafting than the mere twirling successfully of a compass and a good working knowledge of Euclid.

Among other things, there are required an infinite patience, not only with the tools themselves but with one's superiors; a willingness to be haunted o' nights that a certain cam will give required results, or a lever in its work clear the frame, or an odd-shaped piece transcribing an odd-shaped curve pass through its cycle correctly and as drawn; and lastly, and more than all else, a Job-like stoicism that will resignedly see a man in overalls in the same establishment step out and upward via the erecting route to a position of comparative ease and big compensation, while you yourself continue on the board because the chief cannot secure a man who knows the work as well as you do.

"Once a draftsman always a draftsman" is a true adage. Given positive knowledge of the inside, few machinists would care to make the change, and every last one of them would refrain from harsh criticism upon discovering petty errors on drawings. Raise the point—sure! But with a little less rasp in your voice, my brothers!

The reason for the long-standing strife between shop and drafting room is simple to understand. It is a very human reason. It lies in the fact that one department catches the errors made by the other. Draftsmen do not get sore when their fellow-draftsmen point out discrepancies in their work. Perhaps this is true because of the understanding that exists among draftsmen relative to their own general difficulties. But it certainly does start the blood boiling in a draftsman when a grinning machinist points out an error in a drawing. If the man only would not grin; or if he must grin, then show by some sympathetic gleam in his eyes that he understands the nature of the draftsman's work and difficulties! He has one on you, and he is proud of it, and he does not care who knows it. But it is not a feeling of brotherhood.

Errors repeatedly creep into a man's work, regardless of how clever and capable and careful he is as a draftsman. An error in figures is one of the most common mistakes that occur in drafting rooms—and the most dangerous. Also, it is the most subtle, the most insidious, the most mysterious of mental accidents. A draftsman may, and generally does, have the correct figure in his mind when he essays to put it down. Somewhere between the act of dipping his pen in the ink and that of setting his hand to the tracing, to establish for all time that figure on the drawing—Zip!—something happens, the mental figure backs up and without reason becomes something else. The mistake is made.

If the draftsman does not detect his mistake when checking his work finally before handing it over to the regular checker—and every draftsman ought to do that—and if the regular checker also fails to catch the error, the thing then rests calmly and easefully in the laps of the gods. Usually these gods take form in the shape of a frowning man in overalls and jumper, with a steel rule in one hand and a pair of calipers in the other. Then, once more, the draftsman is dragged over the coals, if not actually fired—all depending upon the seriousness of the loss. Once more, the old, old strife is given fresh impetus.

Nor can anything be said in excuse for the draftsman who makes a mistake in figures, save that he is human and that for every error he registers he also registers a hundred successes and that, finally, all he has to guide him is his hand and his eyes—never a jig nor a gage nor an automatic machine built to reduce mistakes to a minimum. That long-heralded mistake-preventing drafting machine has not as yet made its eagerly expected appearance. When it comes, draftsmen will all gladly heave a sigh of relief.

A body of sensitive men, as a rule conscientious, always alert, quick as an aspen to sense complaint, ever striving toward perfection in their work—draftsmen are the nerves of the manufacturing business. Inventors and engineers, granted, are the soul; mechanics, the body of the organization. Draftsmen, from the nature of their work, together with their location in the plant, are the veritable nerves of the organization. Any physician will tell you to conserve your nerves as much as possible. Any observer aware of the true conditions in the manufacturing world today will tell you, for the good both of the body of your organization and the soul, to conserve your draftsmen. That, among other things, means to cut out the shop strife.

*Extract from a paper by Charles M. Horton in the "American Machinist."

American Steel Ships Under Construction are now of greater tonnage than ever before in the history of the country, according to the Bureau of Navigation, Department of Commerce. Steel merchant vessels building or under contract to be built in private American shipyards on Jan. 1, 1917, number 403, of 1,495,601 gross tons. During December, 1916, American yards finished nine steel merchant vessels of 24,363 gross tons and made contracts for 29 vessels of 105,120 tons.

Notes from Field and Office

Three special concrete plants—Repairing old wood piles with concrete—How to finish concrete roads—Road-oiling truck developed—Speed checks devised for track approach to drawbridge

Concreting Plants for Culverts and Bridges on the Southern Ry.

Among the dozen or more concrete structures under construction on the relocation of the Southern Ry. in South Carolina are four of such different nature that their several concreting plants form an interesting comparison. These particular structures are a 40-ft. arch culvert at Richmond Creek, an underpass for a road built after the rock-fill was finished, and two bridges, one crossing the Little Chauga River, the other the Seneca.

The Big Culvert—largest under construction on the Southern—is in rather treacherous ground, necessitating very deep sheetpiling for the foundation. This sheeting is wood, 24 ft. long, put down by a 2000-lb. drophammer, sketched in *Engineering News*, Dec. 7, 1916, p. 1092. The concrete plant is shown in Fig. 1. The materials are handled in 4-yd. cars a distance of 2000 ft. from the railway. The stone comes to the siding in drop-bottom cars that dump into bins, under which the 4-yd. cars load.

At the site the cars run up on a trestle over the material bins, which are about 20 ft. above ground. The mixer is directly in front of the bins, while between it and the south-wall forms of the culvert is a 40-ft. tower, from which runs a chute, as shown. Filler stones weighing 5 to 20 lb. are placed in the forms by hand. Men work the concrete around in the base forms. The total yardage is 6000.

Near the Tugaloo River the new line is on a rock-fill. After the fill had been about half completed, it was found that an underpass for a road would have to be put through. The fill had to be blasted and a concrete box

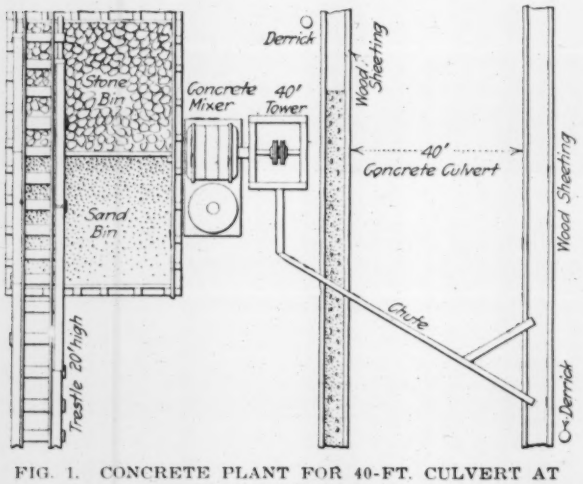


FIG. 1. CONCRETE PLANT FOR 40-FT. CULVERT AT RICHLAND CREEK, S. C.

built. It was necessary to rush this work, which was commenced alongside the road and outside the fill, starting at the west base line of the future fill. The trenches for the wall footings were in rock, and between these a working platform was erected to carry a baby mixer.

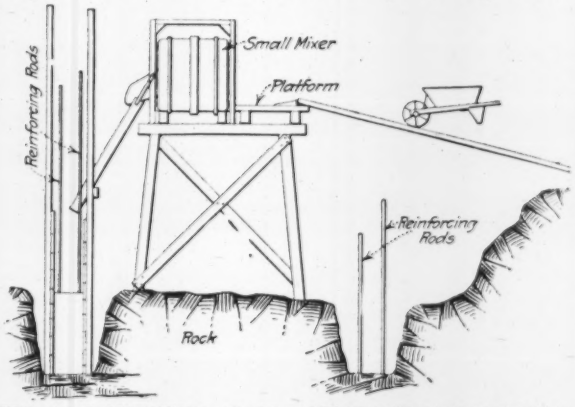


FIG. 2. CONCRETING WALLS OF UNDERPASS THROUGH ROCK FILL

Concrete materials were supplied to the mixer by wheelbarrow over a runway connecting platform and road. (See Fig. 2.)

The Chauga River bridge has square, hollow, concrete piers and two solid concrete abutments. The layout of the concrete plant is shown in Fig. 3. Local sand is used. It is pumped from the creek in the daytime, and the hole thus made in the bottom fills up overnight. This sand is stored in a bin. Granite screenings also are used; stone is brought from a quarry by cars hoisted up an incline to the bins by a cable. Steam is furnished by a traction boiler, which was with considerable difficulty let down the steep hillside to the present location.

The concrete is distributed by a 400-ft. cableway and by a chute from a 40-ft. tower erected alongside the mixer. Rocks of two-man size are placed in the forms, and concrete is run all around them.

The Seneca River bridge is the most northerly structure on the 50-mi. relocation. It is 1000 ft. long and has eight piers and two abutments. The deck-girder spans are 100 ft., and at this season are 80 ft. above the water. The bridge is built right alongside the old crossing (stone piers, trusses and girders), is level and 20 ft. higher.

The pier foundations are 41 ft. 8 in. by 19 ft. 8 in. in plan by from 26 to 38 ft. deep. The excavation was earth and was taken out by hand. A derrick handled the three 3-sided wooden skips that were used. These were filled by men, lifted by derrick and swung down to the river bank, where they were dumped.

The proximity of the existing track of the Southern made the procuring of materials a simple matter. A

...ort trestle was built out from the track and over the ...pe near the north abutment of the new bridge, and ...aterial bins with sloping sides were erected underneath. One of the bins is for coal, and the other is for stone.

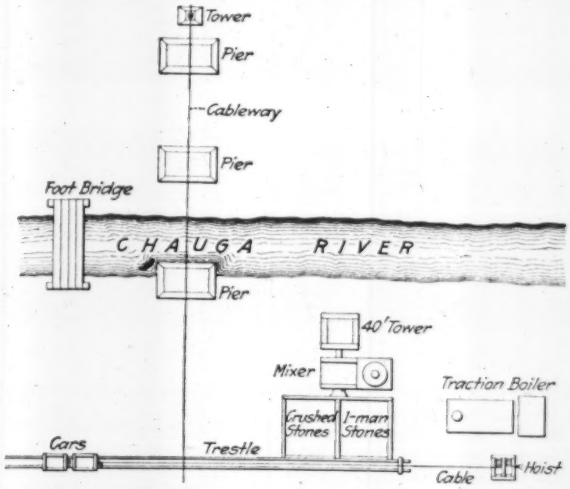


FIG. 3. HOW FOUNDATIONS OF LITTLE CHAUGA BRIDGE ARE CONCRETED

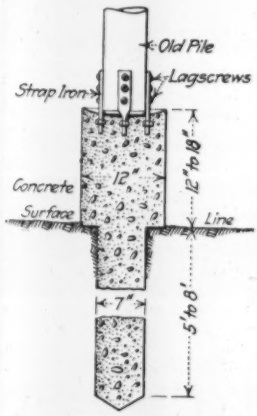
Sand is piled alongside the bins. The cement house is located near the sand pile. Concrete is distributed by a cableway.

The entire 50 mi. of second-tracking is going forward under the direction of R. O. Parsons, Assistant Engineer of the Southern Ry., with an office in Toccoa, Ga. R. F. Ezzell is in general charge of all the construction work on the Southern between Washington and Atlanta, which includes this 50-mi. strip.

Concrete Bases for Old Bridge Piles

By E. V. Moone*

Replacing piling under wood bridges still in fairly good repair as to caps, joists and flooring has been one of the big items of expense in Sedgwick County for years past. The county is now doing a great deal of permanent bridge and culvert construction, but there are still many pile bridges over the larger streams which will have to be maintained for a number of years to come. To reduce this expense we have been putting concrete bases under the piles that have rotted dangerously at the ground line. Replacing a pile always necessitates tearing up the deck of the bridge, removing at least two or three joists and frequently the cap, and sometimes requires falsework for the pile-driver. Where we have been able to work on the ground and have had soil that would stand, a repair gang has put in a concrete base, retaining the upper part of the old pile. The chief difficulty has been to get down past the root of the pile. This has been surmounted in most cases either by pulling or digging out the lower part of the pile, or by moving the top of the pile slightly.



BASE FOR OLD PILE

A 7-in. post augur drills the holes to a depth of 5 to 8 ft. Sometimes the holes are reamed out by a "jabbing digger" or a pile spade, which operation allows a mushroom base to be formed. Where shale or a very hard clay subsoil is encountered—even though only a few feet under the surface—we never try to penetrate it; nor have we tried to put down these holes or build bases where there is surface water. On several occasions we succeeded in holding the excavation open with considerable water in the hole, below the surface. In a number of instances where sand was struck below the surface, this sand was thoroughly mixed with a sackful or less of cement, thus forming a base that holds satisfactorily. This construction, however, is never attempted except where the surface soil is firm and hard.

After filling the hole with concrete, a round sheet-metal form, a little larger in diameter than the hole, is placed at the surface. In the form three or four iron straps are placed, so that they will project 8 to 12 in. above the concrete. Each strap is drilled for two lag-screws, and the straps are placed so that the pile slips between them.

The top of the base is pressed down or cupped, using either a wood form or a trowel. This device helps to keep the pile firmly in place. The concrete sets for 48 hr. before the pile, which is secured with the lagscrews, is placed.

A number of bridges thus repaired have sustained heavy floods without damage. Under favorable conditions this method of repair is much cheaper than replacing old piles with new, and it seems to be more lasting.

*County Engineer, Sedgwick County, Wichita, Kan.

Belt Method of Finishing Concrete Pavements Recommended

The canvas-belt method of finishing concrete-pavement surfaces, first used in Wayne County, Michigan, and described in *Engineering News*, Oct. 5, 1916, p. 654, is highly recommended by H. B. Bushnell, division engineer, Illinois State Highway Commission, in the December issue of *Illinois Highways*. What follows is substantially in Mr. Bushnell's words.

If the floating with an ordinary wood float takes place soon after the concrete is struck off, it invites water and stone pockets and a film coating of cement and the lighter impurities in the aggregate, on the surface of the pavement. Late floating insures a better wearing surface and greater freedom from stony pockets, but it is often difficult to insure that the floating is done at just the right time. At the end of a day's run the floater is generally permitted to work close to the strikeboard in order to avoid finishing after dark. After noon hour, in hot weather, the concrete often is found too stiff to float well. A sudden shower may make it impossible to get over the surface, even hurriedly with the hand float before it is necessary to cover the pavement with canvas.

Good finishers are scarce. Even with the most experienced men there is a tendency to float spots that are low and flat, due principally to the fact that the finisher concentrates his efforts over a very small area. As the

wearing surface, the most noticeable and one of the most important points in the pavement, is left to an ordinary workman for the finishing touches, the personal equation of this workman is of vital importance to a satisfactory product.

Soon after the canvas-belt method of finishing became known, it was adopted by a road contractor in Kane County, Illinois. Two belts were secured—one 3-ply 8-in. canvas belt and one 5-ply 10-in. belt, both having a composition rubber covering. The concrete was mixed at such consistency that when deposited in a pile it would tend to flatten but would not run at the edges. The concrete was struck off in the usual manner; and after the surplus water disappeared from the surface of the concrete, the 8-in. belt was dragged back and forth over the pavement with practically the same motion as used for the strikeboard. Ridges in the mortar are very noticeable after this first floating.

Just prior to the concrete taking its initial set the pavement is gone over a second time with the belt. This second floating grinds down all the ridges left after the first floating. The second floating leaves a gritty, granular mortar surface entirely free from ridges, flat spots or pockets. It was found that better results could be secured by the use of a 10-in. belt for the second floating because of its greater weight; but if the heavier belt was used for the first floating, it had a tendency to flatten the crown in the soft concrete and to dig into the surface.

During the past few weeks eight other contractors on state-aid work in northeastern Illinois have commenced to use these belts. Some of them have purchased new canvas belts and have had considerable difficulty, due to the stiffness of the material. This defect can readily be remedied by shipping the belt enough to limber it up. The plain canvas belt pulls harder than when covered with rubber, but not to such an extent as to be objectionable.

In Kane County the contractor is placing from 600 to 800 sq.yd. of 18-ft. concrete pavement per day and has no finisher on the payroll. The strikeboard men handle the belt and do the edging. Where armored joints are used, it is necessary to do a small amount of hand floating around the joint, but this is done by the men who place the joints.

This construction feature appeals to the contractor, as it saves him money and the worry of keeping a good finisher on the job; and it appeals to the engineer because of the superior surface and the fact that its operation is nearly "foolproof."

Combination Oiling and Utility Motor Truck Used in Los Angeles

By W. B. Cannon*

A new motor-truck outfit for general roadwork in Los Angeles County, California, has been worked out from a big oil spreader. It was seen that oil could not be spread in bad weather, so flat and dump bodies were provided. This keeps the truck driver busy and prevents the useless expense of a high-priced machine standing idle.

The spreader has a tank and pump unit that can be lifted off after disconnecting the pump chain and loosening a few bolts. The spreading header can then be dropped down, leaving the chassis free for another body. With the other body mounted on a separate frame and suitable hoists provided for lifting the bodies, the shift can be made in 1½ hr.

The oil-spreading body was designed to eliminate the common evils of oiling trucks and to do several new things. First, the tank was covered with asbestos; then the pump was put inside the tank so that whenever the oil was warm enough to spread, the pump would start. The pump was built into a flat casting about 18x24 in. and ⅝ in. thick. This was bolted to the front tank head with a gasket to prevent leakage.

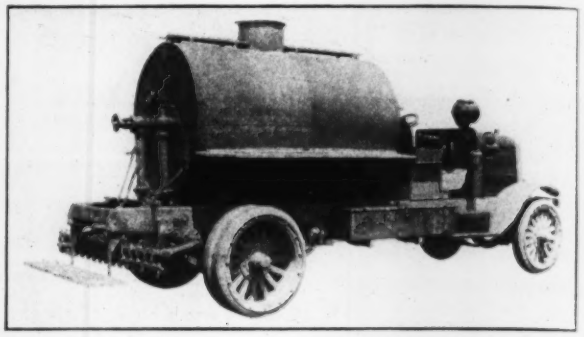


FIG. 1. LOS ANGELES OILING AND UTILITY TRUCK

The rotating members are two steel 10-tooth 1½-in. diameter, 5-in. face hobbed pinions. The case projects back into the tank (see Fig. 2). The pump cover is bolted to the front of the case so that the pinions can be exposed and removed without unbolting the case from the tank (after cutting the pump off from the oil if the tank is filled).

Just below the pump chamber is a threeway cock built into the casting, and at the left of the cock is a side outlet that can be connected to the pump, tank or shut-off, by turning the cock. From underneath the cock the suction goes down to a small pump in the front end of the tank. Just above the pump chamber the discharge forms a T, with one outlet coming out through the face

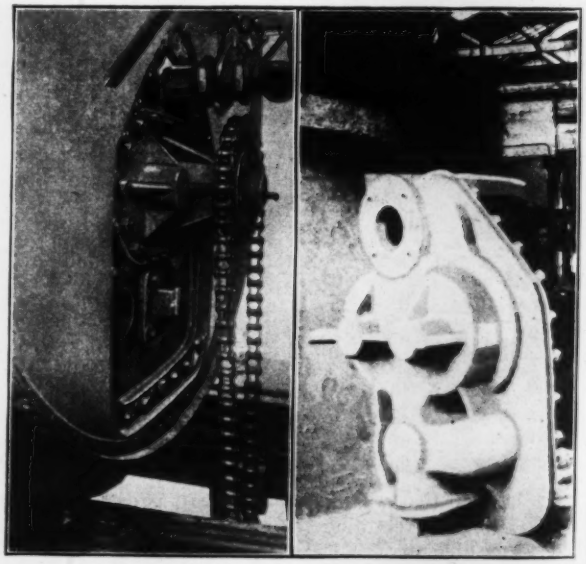


FIG. 2. TRUCK PUMP IN PLACE AND REMOVED

*Route 2, San Gabriel, Calif.

of the pump casting and the other going to the rear of the tank. The pump can take its suction either from inside or outside the tank and discharge into it or outside. At 500 r.p.m. the pump will handle about 200 gal. per min. up to 200 lb. pressure, or the limit of the motor. Power is obtained by a chain from the countershaft in the transmission, which is extended through the case and a cutoff coupling put on.

The pump discharge goes through the back head of the tank, about a foot to the left of the center, and turns down through an angle stop valve. The oil goes down to the left end of the spreader header, crosses over the right and goes up and into the tank through a spring-loaded relief valve. By adjusting this valve the pressure of the oil in the spreader is varied.

The spreader was intended to be as flexible as possible and, by the right combination of nozzle opening, truck speed and oil pressure, will spread from ⅛ to 1¼ gal. per sq.yd., and this in a strip of from 6 in. to 8 ft. wide. The nozzles can (1) all be turned on or off at once, or (2) each half can be controlled separately, or (3) each nozzle can be opened independently until they are all open and then the whole bank turned off at once, or (4) they can be opened at once and closed independently. The cocks are special and carry two nozzles; a 30° turn of the handle in either direction gives full opening. The end of the header is tapped for a 2-in. pipe, and a gate valve with an extension header can be screwed on for oiling shoulders and gutters.

This equipment was worked out by the writer, as chief road oiler of the Los Angeles County Road Department, under Grant Friel, Superintendent of Maintenance, and F. H. Joyner, Road Commissioner.

Crushed Stone Used on Sand Tracks After Tests by Boston Elevated Ry.

Tests of speed-checking tracks have been made by the Boston Elevated Railway Co. since the disaster of Nov. 7, 1916, when a surface car crashed through a drawbridge gate and went over the edge of the draw, drowning 46 people. The company operates eight-car elevated and two-car surface trains over structures in which are draws, and since the accident mentioned the company has felt that automatic signals and train stops or bumpers are not sufficient precautions. Some form of sand track was considered the only available further protection, but tests were desired before construction was started.

A 300-ft. length of track in a storage yard was fitted up as shown in the accompanying sketch and check ballasted in turn with (1) sand, (2) clean, round, beach pebbles and (3) 1-in. crushed stone. The crushed stone gave the best results, reports H. M. Steward, Chief Engineer of Maintenance-of-Way. Cars of any type could be run into the stone at fairly high speeds and stopped with absolute safety, the braking being smoother than emergency application of train brakes. The wheels did not cut through the stone to come in contact with the plank. The trains ran in practically straight lines—in no tests were the cars more than ½ in. out of line.

The broken stone crushed somewhat under the M. C. B. wheels, and the train was raised about 1 in. The impression of the wheels was left in the stone, and the material was not compacted as much as was expected.

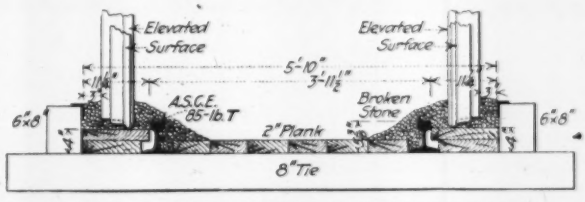
CAR AND TRAIN TEST ON SAND TRACK AT FOREST HILLS YARD, BOSTON ELEVATED RAILWAY CO.

Type of Car or Train	Speeds Previous to Brake Application, Mi. per Hr.	Braking Ft.	Braking Mi. per Hr. per Sec.*	Material in Trough	Condition of Material
20-ft. box-car	11 8	43	2 5	Sand	Dry
20-ft. box-car	14 8	54	3 2	Sand	Dry
4A3 semi-convertible car	15 0	62	3 5	Sand	Dry
4A3 semi-convertible car	19 0	98	3 2	Sand	Dry
4A3 semi-convertible car	19 5	96	3 4	Sand	Dry
4A3 semi-convertible car	19 0	97	3 2	Beach pebbles	Dry
4A3 semi-convertible car	18 5	94	3 2	Beach pebbles	Dry
4A3 semi-convertible car	21 0	89	4 4	1-in. crushed stone	Dry
4A3 semi-convertible car	20 0	90	3 9	1-in. crushed stone	Dry
4A3 semi-convertible car	21 5	112	3 5	1-in. crushed stone	Dry
2-car train	24 5	177	3 3	1-in. crushed stone	Dry
3-car train	24 0	200	3 1	1-in. crushed stone	Dry
4-car train	23 0	215	3 0	1-in. crushed stone	Dry
4-car train	22 0	173	4 1	1-in. crushed stone	Dry
4-car train	26 0	232	3 7	1-in. crushed stone	Dry
4-car train	24 0	193	4 0	1-in. crushed stone	Moist†
4-car train	23 0	203	3 3	1-in. crushed stone	Moist†

* Rate of deceleration calculated as follows: One-half distance between center line of first wheel and last wheel on car or train subtracted from actual feet required to stop, this giving a length on which rate of deceleration was figured. The amounts subtracted in the various instances are as follows: For 20-ft. cars, 3 ft; semi-convertible cars, 15 ft.; elevated 2-car trains, 43 ft.; elevated 3-car trains, 64 ft.; elevated 4-car trains, 86 ft. † Mixed with sand and pebbles.

One surprising fact was the ease with which the trains were pulled back upon the running track. The accompanying table shows the test results in more detail.

The company has decided to install, on one side of the draw where eight-car elevated trains are operated, a track of this construction lying between the two existing



CROSS-SECTION OF BOSTON EXPERIMENTAL SAND TRACK

main-line tracks. This will cost about $40,000. Also gauntlet checking tracks will be built on both sides of the draw where two-car surface trains are operated; these will cost $5000 apiece. It will be necessary to cover the check ballast with tar paper or painted canvas to keep it dry and to prevent freezing in cold weather.

Hints for Use of Cold Mixtures for Bituminous-Pavement Patching*

The character of the mixture to use in patching bituminous concrete pavements depends entirely upon the conditions encountered. Unless the patching work is extensive, it is not advisable to use hot bituminous compounds in repair work, not only from an economic standpoint, but also from the point of convenience, for in small repairs the use of a mixing plant will materially increase the cost and entail unnecessary effort. Of course, where sections of considerable area are to be replaced, a mixing plant may become necessary.

Bituminous materials are being manufactured that can be mixed cold with the aggregates and tamped and rolled into place quite conveniently and inexpensively, and these have given good results. The different companies manu-

*From an article by George H. Biles, Second Deputy State Highway Commissioner, in the December issue of the "Pennsylvania Highway News."

facturing these materials have their own specifications for each particular product.

General practice seems to demonstrate that cold mixtures in the proportions of one part bituminous material to nine parts of ½-in. stone are quite satisfactory for all practical purposes. The material may be mixed on the road surface in a manner similar to the method used in mixing cement concrete, but care must be taken to remove the excess after the completion of the work.

In spreading bituminous concretes the tines of the rake should not be used in raking it into place, as this will cause a separation of the materials and the large aggregate will come to the top. The back of the rake will accomplish this work more satisfactorily.

Should depressions occur after the initial compression and rolling, the surface should be loosened up before additional material is applied to bring up the unevenness. Numerous cases may be found where repairs to roads of this type have not proved satisfactory. They are caused generally by the use of crude or improper methods or unsuitable material.

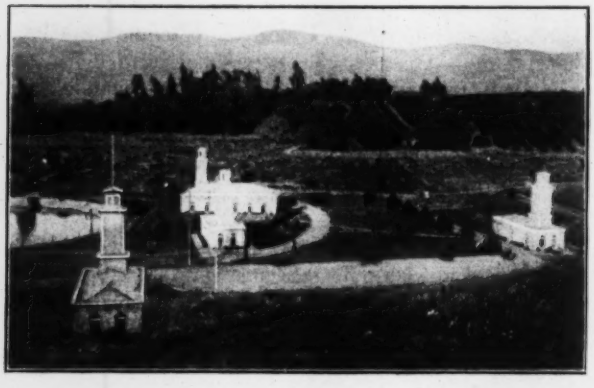
A patch should neither be above nor below the level of the surrounding surface to insure success and should be compacted as nearly as possible to approach the material in the road. Never place a bituminous patch on top of a bituminous surface to bring up a depression, unless the surface material has been heated and scored properly. It is always better to cut out the area and supply new material. A patch with a feather edge is but a temporary expedient and in a short time is sure to fail.

Fatty patches, which are caused by an excess amount of bituminous material in the mix, produce considerable unevenness in the surface of the road and are most unstable.

NOTES

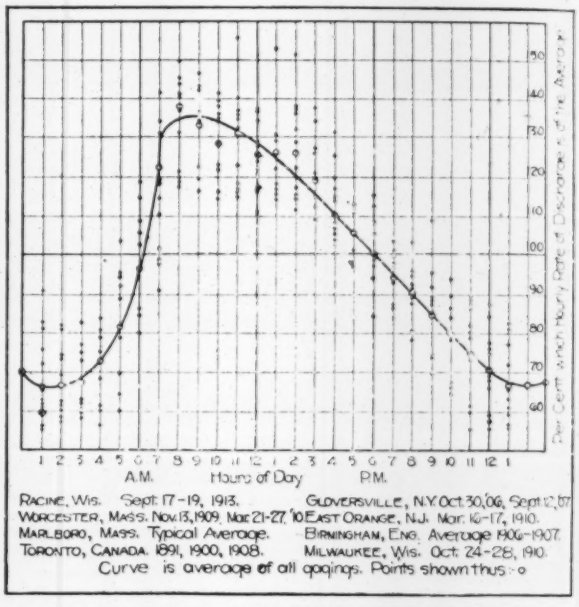
A Record Drilling Performance in which a "Jackhamer" put down one hundred 4-ft. holes in 10 hours at the quarry of the Alabama Marble Co. is reported by the Ingersoll-Rand Co. This is drilling at the rate of 8 in. each minute of the day's work. The holes were nearly vertical and only a few inches apart. They were used for plug-and-feathers work. The drill worked at 100- to 110-lb. air pressure.

The Deep-Well Pumping Plants of Redlands, Calif., shown in the accompanying view, were constructed in 1913. The pumphouses are of reinforced concrete, and the towers are provided to cover the derricks used in pulling the pump rods. The wells being in sand and gravel formation, it seemed desirable to locate them some distance apart, which necessitated the construction of several buildings to cover the different pumps. These pumps are of the triplex deep-well type, having a capacity of 900 gal. per min. each. They have run constantly since their installation and have proved to be very efficient and economical in operation. The water lift is about 140 ft., and the depth of the wells varies from 250 to 700 ft. The total capacity of the plant is 7650 gal. per min. The deep-well triplex pumps operate at about the same efficiency as the single-acting triplex booster pumps, of which there are three in these buildings, to raise a portion of the water to the higher levels of the city. The foregoing information was furnished by George S. Hinckley, city engineer, Redlands, Calif.



DEEP-WELL PUMPING PLANTS—NOT CHURCHES

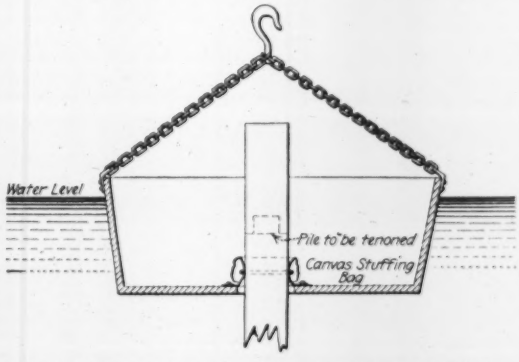
Hourly Sewage Flow Variation—The accompanying diagram is a composite of the hourly variation in sewage flow in six cities of the United States and in Toronto, Canada,


Per Cent of Hourly Rate of Discharge to the Average
50
40
30
120
110
100
90
80
70
60
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12 1
A.M. Hours of Day P.M.
Racine, Wis. Sept. 17-19, 1913.
Gloversville, N.Y. Oct. 30, 06, Sept. 2, 07
Worcester, Mass. Nov. 13, 1909, Mar. 21-27, '10
East Orange, N.J. Mar. 16-17, 1910.
Marlboro, Mass. Typical Average.
Birmingham, Eng. Average 1906-1907.
Toronto, Canada. 1891, 1900, 1908.
Milwaukee, Wis. Oct. 24-28, 1910.
Curve is average of all gagings. Points shown thus :-o

COMPOSITE CURVE FOR HOURLY SEWAGE FLOW IN VARIOUS CITIES

and Birmingham, England. It is reproduced from a recently published report on sewerage improvements at Davenport, Iowa, by John W. Alvord, consulting engineer, Chicago.

Cutting Piles under Water in very cold weather was done in Holland by using a large ballasted wooden trough or tub with a hole cut in the bottom for passing over the pile to be cut. Jan Spaander, 618 Forty-Fifth St., Brooklyn, N. Y., describes the application of this method to a special job, as shown in the sketch. A contractor was called upon to



WORKING TUB FOR CUTTING PILES BELOW WATER LEVEL

replace the superstructures of 15 wooden bridges over a navigable canal. The piles had to be cut off 14 in. below low-water mark and provided with tenons to accommodate cross-beams for supporting the new structure. A crane lifted the working trough over the piles and lowered it a sufficient depth in the water. Leakage at the hole was checked by a canvas bag encircling the pile and fastened to the floor of the trough.

Editorials

Why Not Two Concrete Mixers?

One very definite change in the 1916 report of the Joint Committee on Concrete and Reinforced Concrete was the recommendation that for normal mixers the batch should be kept in motion for at least 1½ min.—a 50% increase over the recommendation of the earlier report. This is in line with the best of current thought on concrete making and is the confessed ideal of many engineers. Unfortunately it is more than often an unattained ideal—unless it may be that concrete foremen's watches invariably run fast. The fact is that the average foreman more frequently aims to shave the mixer saleman's "batch-a-minute" than to follow the high-minded advice of the Joint Committee.

A solution of the difficulty too infrequently tried is the use of multiple mixers at one mixing plant, two or more drums all run by the same engine, all fed from the same bins and all delivering to the same chute, bucket or car. On very large works such as the Halifax harbor job or the McCall Ferry power plant such a battery of mixers is required by the large volume of concrete; but at times in such plants the mixers can be run simultaneously, feeding and dumping alternately, so that with three mixers running, each batch can be mixed 90 sec. and a batch dumped every 50 sec., leaving 20 sec. for loading and dumping operations at each mixer.

Why should not the same idea be applied to smaller jobs where one mixer dumping—under forced draft—every minute is the contractor's ideal? Here, for a very little greater first cost and hardly any addition to upkeep, two mixers could form a battery to work alternately, revolving the mixture long enough to suit the engineer and dumping fast enough to suit the foreman.

Sand or Mortar Bedding for Paving Bricks Still a Live Issue

The very much discussed point in brick and block-pavement construction, "Is a sand cushion really a *cushion?*" seems to have been answered in the affirmative by the United States Office of Public Roads and Rural Engineering, if the tests described elsewhere in this issue by Prevost Hubbard are accepted as meaning anything.

It has been the fashion lately to decry the term "sand cushion" as a misnomer and to theorize that closely confined and compacted sand under a pavement surface is as rigid as a layer of mortar. The tests made in Washington show that an impact hammer rebounded three times as far from a monolithic brick-pavement slab as from one that had a 1 or 2-in. sand cushion between the brick and the concrete base.

These tests confirmed the theory that a fracture of the brick wearing surface in the monolithic type of construction means fracture of the base also, thus getting away from the ideal pavement, which consists of a permanent foundation and a replaceable wearing surface. The most interesting feature of the tests in this respect was that brick bedded in a 6-in. concrete foundation to form a monolithic slab stood no greater impact than the brick laid on a sand cushion. It is significant, however, that the grout bond between the bricks failed under about half the impact required to fracture the brick, in the case of the sand cushion, and at nearly the same impact which fractured the brick in the case of the monolithic slab.

Interesting and conclusive as these tests are, so far as they go, the question is at once raised, What connection is there between laboratory hammer-impact tests and the experience of a pavement in actual service on the road? So long as a pavement is new and smooth, it is true that it will probably get little impact under any kind of traffic; but let there be a slight hump or depression, or a bit of hard stone, a bolt, bar or other obstruction on the surface, or an imperfect wheel, and there is bound to be impact or pounding under present-day high-speed motor-truck traffic.

The maximum breaking impact in the tests described was a 10-kg. hammer falling 95 cm., which is equivalent to 950 cm.-kg., or 825 in.-lb., which is the same as an 825-lb. weight falling 1 in. or a 1650-lb. weight ½ in.

The load on each of the rear wheels of the motor trucks that recently have destroyed granite-block pavements in New York City are approximately 12,000 lb., which means that one of them would have to drop but 0.07 in., or a trifle more than $\frac{1}{16}$ in., to have theoretically the same result as the impact hammer used in the tests, provided the full load came on one brick, as might happen due to slight inequalities of surface. The tires of these trucks are 8 in. wide; so if the load was distributed over the full width of two bricks, the drop necessary to cause a fracture of both bricks would be only ⅛ in.

It would seem from this brief computation that there exists a real relation between the impact tests made in the Washington laboratory and the experience of pavements on streets and roads.

New York's Garbage-Reduction Fuss

Again the expected has happened. After all the fussing, blowing and threatening over the location of garbage-reduction works for New York City on Staten Island, including 12 days of hearings and 1700 pages of typewritten testimony before representatives of the State Department of Health, under reference from Governor Whitman at the instance of Staten Islanders, the whole matter comes to nothing. First, George C. Whipple, the consulting sanitary expert engaged by the State Department of Health to sit through the hearings and report on the whole matter, declared that neither the transportation of the garbage in scows to Staten Island nor the treatment of the garbage there by the Cobwell reduction system would be a menace to health, although each might cause some local nuisance and other sites would have been preferable. These sites, however, were barred out when the contract was awarded. Next, Deputy Commissioner Williams and then Commissioner Biggs

after the concurrence of Chief Engineer Horton (all of the State Department of Health) indorsed the substance of Mr. Whipple's findings. This brought the matter back to roost with Governor Whitman, as stated on p. 125 of *Engineering News* of Jan. 18, 1917. Now comes Governor Whitman with a declaration that he has no jurisdiction over anticipated nuisances. Meanwhile the contractors have the work well on toward completion.

All this seems farcical enough. It appears still more so when it is noted that at the very outset of this tempest in a teapot, J. T. Fetherston, Commissioner of Street Cleaning, told the Staten Islanders what the law on the subject was and that they could choose between an action for nuisance after the plant was in operation and a big but futile demonstration meanwhile. A big hue and cry with no chance of a successful outcome on sanitary or legal grounds was the choice made, with the result to be expected.

This controversy required a large amount of time on the part of high officials in the State Department of Health, who might a hundred times better have been at work on real health-protective matters. It required much time on the part of others, as well as no inconsiderable cash outlay, that might have been far better used. But in some respects the worst feature of the whole proceedings was the spectacle of professional men who certainly ought to have known better solemnly testifying that an uptodate garbage-reduction works would be a menace to health. Such testimony hurts the professions of those who give it and by misleading the public delays public-health advance.

Wetting Down a Dry-Mixed Concrete

The problem of distributing concrete over a long-distance job—such work as the construction of a sewer, a pipe line or a subway—admits of numerous solutions. The plant designer can have small movable concreting plants delivering directly to the work and loading at frequent storage places, he can have frequent fixed plants with short-distance delivery by cableway, chute or derrick, or he can have one fixed concreting plant with long-distance delivery by train or truck.

The latter method itself has two variations: The concrete may be mixed normally and delivered wet to the forms, or it may be mixed and delivered dry and then wet down just before placing. Wet delivery has not proved very acceptable because of the segregation of the aggregate and the slopping over of the containers, so of late a number of contractors have tried the dry mix and delivery instead.

From the information received in the recent prize contest, in which Mr. La Brecque's paper on another page was awarded first prize, it seems that complete dry mix and delivery have their drawbacks and that some water has to be added at the central plant if labor costs at both mixer and forms are not to be prohibitive. The difficulties of the sloppy mix are then obviated, but there still remain the labor at the forms and the possibility of not thoroughly distributing the water to the cement particles.

Is there not a chance to improve the method by the use of one of the much despised trough continuous mixers or a baffled trough of gravity action? Such a mixer could readily be moved from place to place and be set up at the form, and the dry or semi-dry mix could run through it with a minimum of cost and time. In this way the advantages of central dry mixing could be retained; at the same time the preliminary mixing should be sufficient to permit a thorough mixing at the forms, for although the trough mixer is not efficient for total mixing, it might supply sufficient turning over to wet down aggregates already well mixed.

Europe's Needs After the War

There has been a very general belief in the United States that when the war terminates and the pressing demand from Europe for war supplies comes to an end, there will be such a slump in exports from the United States that business depression here will result. Those who have held this view have failed to realize that Europe after the war will be under the urgent necessity of restoring as promptly as possible its dislocated industries and must turn to the United States for a great part of the necessary materials and machinery.

A remarkable picture of the situation in Europe is drawn in the report of the American Industrial Commission, just made public. This commission of prominent American engineers and business men, which visited Europe a few months ago on behalf of the American Manufacturers Export Association, obtained from official sources a large amount of data as to the work of reconstruction.

The picture that the commission draws is of a vast extent of country over which the destructive wave of war has rolled and in which towns and cities must be rebuilt, roads and bridges must be restored, factories must have new machinery and new stocks of raw material. Even in the goods for immediate consumption, such as food products and materials for clothing, it will be many months before a sufficient amount can be carried to Europe to relieve the most urgent necessity; and it will be years before such a normal surplus of the necessaries of life can be accumulated there as existed before the war.

It is often forgotten that the effects of the war have not merely been felt in the hostile zone. Throughout Europe, all energies and expenditures have been of necessity turned aside from ordinary channels and directed toward the one supreme object of national defense. The cities of Great Britain, for example, have for nearly three years now been prohibited from borrowing money to make the usual extensions of water, gas and sewerage works, railways and lighting plants. Only the necessary maintenance work has been permitted. This is typical of what has gone on in the affairs of every corporation and every individual all over Europe. The work of repair, replacement and extension will have to be undertaken everywhere, whenever the stoppage of the war demands will permit.

What we are now face to face with and shall be for a long time is a condition of world-wide scarcity. It could not be otherwise. Fourteen of the chief nations of the world have for nearly three years been diverting to the task of destruction the energy formerly devoted to production. It is true that idlers have been set at work and that men and women by millions have labored with abnormal intensity, but that is far from offsetting the loss to productive work of the millions engaged in war and the supply of war's necessities.

A great deal has been printed concerning the marvelous efficiency in production that will result from the strenuous discipline of the war and the lessons it has taught in organization; but it will take time, and a great deal of time, to equip farmers and manufacturers and miners with sufficient food, raw materials and machines to enable them to operate again under normal conditions.

The Industrial Commission gives interesting figures as to the expenditure required for reconstruction in France alone. Over 750 towns in the war zone have been wholly or partly destroyed, and more than three times that number of towns, with four cities of over 100,000 population, are in the enemies' hands. In France and Belgium alone the immediate needs during the first year after the war will require for the rebuilding of destroyed factories and equipping them with machinery about $200,000,000 for buildings and $700,000,000 worth of machinery. The total destruction of public and private property in the war zone is estimated at about six billion dollars.

The Quality of Column Steel and the Strength of Columns

Another progress report has been rendered by the Steel Columns Committee of the American Society of Civil Engineers. Superficially viewed, this report seems to center about an old, long-known fact. Yet it presents new questions and suggestions in a degree sufficient to make it a most important document. It may, in fact, be called one of the engineering sensations of the season—at least so far as structural engineering is concerned.

The apparently central feature of the report is the "discovery" that the strength of a column depends on the yield-point of the steel. This is a very old discovery. The really important central point, on the other hand, is the committee's announcement of the fact that the quality of column steel is the main factor. This is bound to lead to new thought, to progress.

Early in its work, the committee focused its view on length-ratio and shape of cross-section, if a proper opinion can be drawn from its somewhat formal progress reports. Thereby it was led to undertake or share in a memorable piece of work—a series of experiments far superior in excellence to any prior wrought-column tests and indeed superior to all the prior tests joined together. It can hardly be said, however, that the analysis of length-ratio and shape of cross-section brought forth any notably new facts.

Reduction of strength with increased length-ratio was found, as was to be expected. Different normal column cross-sections showed up pretty nearly alike, as also was to be expected. But secondary factors came to view in the course of the work, and they have turned out to be the important ones.

There was, for instance, the mysterious phenomenon of columns made of thick metal turning out to be weaker than similar columns of thin metal. The materials were supposed to possess approximately equal strength, in specimen tests. But these specimen tests were made only in tension. Not until compression tests were made did the unsuspected fact develop that the materials were not alike, but were very different—different in compressive strength.

Thus, the committee demonstrated a year ago that column material may not be judged in tension. It has strengthened the demonstration during the past year by making a number of compression tests. The bridge builder who buys column steel on the basis of tension tests is in danger of going astray as far as the committee did, when it bought different lots of material and believed them to be of equal strength merely because they gave equal tensile specimen tests. The bridge builder ought to make compression tests, if he wishes to know what he is getting. The fatal difficulty, however, is that compression tests are hard to make, and no one wants to make them—neither the steel mill nor the bridge engineer.

The committee may provide a convenient solution of this difficulty by devising methods and formulas for computing the compressive strength from the (measured) tensile strength. Of course, it may fail in this endeavor; but to make a start with the problem, it is about to study the question, "What is yield-point?"

This question has in the past engaged many minds and has produced numerous papers and discussions. Well may we look forward with interest to whatever new light the column committee can project on it. For the present it is only necessary to remember that many engineers believe in the *a priori* identity of tensile and compressive yield-point, provided both are measured in the right way; if that belief be correct, it would only be necessary to find a way of measuring tensile yield-point so that it will be equal to the compressive yield-point.

Very directly related to the yield-point question is another which the committee is investigating—namely, the effect of eccentric loading, or, stating it in other terms, the effect of moment and direct load combined. Such combined loading necessarily stresses one side of the column more than the other; and if the load be increased sufficiently, one side will reach the yield-point stress before the other. Now, it is possible to attain this yield-point stress on the one side in different ways—by less load and more moment, or by more moment and less load. Will failure take place for the same extreme-fiber stress under these two load arrangements? In all our structural analyses we assume that it will. Yet, strange to say, no experimental evidence on this question is on record. The committee will provide it, we may hope.

These inter-related questions of yield-point and eccentric load represent a very long and highly involved problem. A definite answer can hardly be expected within the year. But, in compensation, the committee promises to report on the influence of details, or in other words on how to design column ends and connections so as to realize the full strength of the shaft.

The principles of perfect column design have not yet been written down in the records of the structural engineer's art. It is not hard to make a perfect column without ends, if we may use such a term; by applying the load to the shaft metal direct, the full strength of the shaft can be developed. What we need to know is how to apply jaw plates and gussets and battens and pin-plates, transfer the full column load through them and still have 100% of the shaft strength available. Some very recent tests, which point to the harmful influence of even a very few rivet holes in a large member, afford a fresh reminder of the difficulties in this field of detailing. The committee will make a lasting name for itself when it writes a comprehensive treatise on 100% detailing of columns.

Letters to the Editor

Wanted: Results of Private Research

Sir—The undersigned committee on Engineering of the General Committee on Research of the American Association for the Advancement of Science feel that it is timely to issue the following appeal to industrial research laboratories.

In the course of work done in the numerous industrial laboratories of America, many physical and commercial constants and data of great scientific interest and value are doubtless arrived at, and which may, for a certain period of time, constitute an asset of considerable commercial value to the particular corporations in question. During this period, everyone recognizes the proprietary right of the industrial laboratories to the retention of this information.

A time frequently arrives, however, when such scientific information loses its commercial value (often by being duplicated in other laboratories), and just at this point we wish to impress upon the industries their obligation to enrich scientific literature with such facts and data, which might otherwise be lost or forgotten.

Some of our industries have been reproached with the suspicion of acting as sponges, in that they absorb an immense amount of useful information from scientific literature without giving any return in kind. This suspicion would be entirely removed if, from time to time, scientific information which has ceased to be of commercial value were contributed by them to its appropriate channel and thus became available to all scientific workers throughout the world.

If any doubt exists as to the appropriate channel for the publication of such scientific data and communications, the secretary of the American Association for the Advancement of Science, Dr. J. McKeen Cattell, Garrison-on-Hudson, New York, will be glad to act as intermediary and to forward such communications to the proper scientific body.

A. E. KENNELLY, J. W. RICHARDS, A. SAUVEUR,
A. N. TALBOT, C. C. THOMAS.

Cambridge, Mass., Jan. 27, 1917.

How To Bind Your "News" Copies

Sir—I notice in the issue of the "Engineering News" for Jan. 11, under the head of "Really Good New Year's Resolutions," that Mr. "Make a Few Resolutions" has made some excellent ones; and while fully agreeing with him that the fewer resolutions made the more apt they are to be kept, I fully believe just one more should be added. It is this: In addition to reading the "News" we should all preserve our copies and bind them for future reference.

Here are a few simple directions for those who would like to bind their copies, but imagine it is a lot of work:

1. Take the papers to a good bench or table and open up the front to the first page of reading matter; hold firmly down to the table and tear off the front advertisement pages.

2. Open up the back and with an awl or other instrument loosen the clinches on the wire staples.

3. Divide the paper at the division between the reading matter and the "Construction News" section and cut through the back at the ends with a knife, to start the division at the proper place; then holding tight as before, pull the back portion loose from the staples.

4. Turn to the front and remove the bits of paper still remaining under the staples; then turn to the back, bend down the staples and clinch with a light hammer.

5. Lay the back to the edge of the table, and with the corner of a triangular file the rough edges of the paper may be easily removed, as well as the glue, leaving the back in good shape for binding

6. Mark two points 2¼ and 9¾ in. from the top and ¼ in. from the edge and punch with a small size harness punch for the wires in the regular binders furnished by the "News." This marking is easily done if one has a carpenter's square available, for the paper can be laid so the top of the papers will be alike and throw all irregularities in the cutting to the bottom.

7. Place in the binder with the index and file for future reference in your bookcase.

WILLIAM R. KINDER.

Troy, Ohio, Jan. 15, 1917.

Percolation Tests of Sewer Pipe

Sir—Permit me through your columns to ask the sentiment among city engineers as to whether or not sewer pipe should be submitted to a percolation test; and if it should, then how severe a test. The general opinion with regard to clay sewer pipe has been that the pipe is impervious. However, a few city specifications have included a percolation test, notably the specifications of Kansas City, as published in "Engineering News" of Apr. 30, 1914.

Recently the City of Tucson, Ariz., included a percolation test in its specifications for a large sewer contract, and the pipe that has been furnished does not fulfill the specification, which calls for a 5-min. test at 15 lb. per sq.in. without sweating. Much of the pipe, indeed, sweats with 5 lb. pressure. As a result the contract was held up for a considerable time, and the Engineering Department was subjected to very severe criticism.

I wrote to the city engineer of Kansas City to inquire the duration of the test for his 10-lb. percolation specification and was suprised to learn from his reply that that particular clause is not used—that is, that no percolation tests are being made. Of course I wrote him again, asking why the clause was included in the specifications if it was not to be used.

The criticism in Tucson was due largely to the fact that the percolation clause was not being enforced, and it was felt by citizens that the clause may have increased the cost of the pipe without accomplishing any good. At that time much of the pipe was already in the ground. The writer, with two other engineers, after examining the pipe and finding that it withstands from 35 to 60 lb. internal pressure and is thoroughly burned, reported to the City Council that it is good pipe and satisfactory for the purpose intended.

Sewer pipe is not subjected ordinarily to more than 1 or 2 lb. pressure, and it is the common belief of engineers, I think, that sewer pipe, either clay or cement, soon becomes sealed tightly and covered with a slime that makes the friction factor quite independent of the material. A slight percolation when the pipe is new might result in a damp soil surrounding the pipe, but oxidation would prevent any objectionable result. Only in case the pipe is laid below or near the ground-water table and in the vicinity of domestic supplies would there be danger of injury.

The engineer of sewers of Kansas City has just submitted a statement of percolation tests made in the past, mostly in 1914. These tests are certainly of great value, well worth publishing in full. Most of the pipe tested were of concrete and ranged in size from 8 in. to 21 in. In general, the pipe withstood 10 lb. and even 15 lb. pressure indefinitely without sweating, and in many cases there was no percolation up to 30 lb., in one case up to 78 lb. Three tests of clay pipe were included. A 15-in. clay pipe showed seepage with 15 lb. pressure after 40 min. and an 8-in. pipe after 50 min., while a 10-in. clay pipe withstood 10 lb. for an hour without signs of seepage, with only two small moist places during the next hour when under 15 lb. pressure, so the engineer was quite justified in assuming that sewer pipe is practically impervious and that testing for percolation is unnecessary. Some tests that have just been made seem to confirm the assumption.

However, pipe made in various parts of the country may be quite variable in character. Undoubtedly the quality of the clay, as well as the method of manufacture, affects the perviousness of the pipe. So it is desirable to know what, if any, should be the minimum requirement to be used in specifications, and many city engineers, I feel sure, will welcome a discussion of the subject.

G. E. P. SMITH.

University of Arizona, Tucson, Dec. 26, 1916.

A Subaqueous Rock-Breaking Machine in use on a number of Government contracts was described in "Engineering News" of Feb. 4, 1909, p. 125, by Burton H. Coffey, M. E. Information is desired as to the present location of Mr. Coffey or of the Submarine Co., which was stated to be the owner of the patents on the apparatus.

Conservancy Case Defeated at Columbus; City To Enlarge River Channel

Defeat of the Franklin County Conservancy District flood-protection project on Jan. 9 ended the hearing before the Conservancy Court, formed of the Franklin County judges, which began Dec. 6. In a preliminary decision the court decided against the proposal to enlarge the district to include the whole area affected by the protection. Then the court ordered testimony presented on the financial practicability of the conservancy plan under the proviso that the whole cost of the plan should be assessed against Franklin County; consideration of the technical features was left for possible subsequent proceedings. On this financial question the court decided Jan. 9 that the cost of the plan is not justified by the benefits:

> Upon a consideration of all the evidence, and giving due consideration to the contention of each side as to the ability of the property in the flood zone to bear the assessments necessary to carry out this proposed plan of improvement, we are unanimously of the opinion that the assessment will be much beyond the benefits likely to be derived from the carrying out of the plan.
>
> We have . . . assumed for the purpose of this hearing, that the plans are efficient and adequate, and will afford the protection claimed for them by the engineers who prepared them. We are only deciding the question of the feasibility of this plan from a financial standpoint.

The decision of the court, though long, gives no clue to why the court reached its decision, nor does it give any measuring stick by which an opinion might be formed as to what expenditure would be confiscatory and what would not be.

Further action on the part of the Conservancy District (which was not dissolved) is in abeyance pending action by the city, which has a channel improvement project of its own. The district has been considering a modified plan, one giving less protection than that passed on by the court but sufficient to just about accommodate the 1913 flood.

The modified plan includes the Dublin retarding basin of the prior project and sufficient channel improvement through Columbus to take the discharge from this basin. It is possible to secure complete protection against a recurrence of the 1913 flood by this modified and cheaper project. The cost to Columbus and Franklin County will be fully as much as under the prior plan if distributed over the whole benefited territory from Delaware to Chillicothe, although the latter plan will take care with safety of a flood 45% greater than the 1913 flood. The modified plan will be much less burdensome to the west side of Columbus, which is the district on which flood benefits must be particularly assessed; the difference will be particularly large if the city undertakes some of the work by general taxation.

Channel Improvement by the City

As the outcome of a proposal made late last fall by a citizen of Columbus that the city enlarge the Scioto River channel through the city to 580 ft. wide, on the claim that this would give complete flood protection, the city has just approved such a plan. City Engineer Henry Maetzel, who investigated the proposal at the direction of the council, reported months ago that the proposed enlargement would carry only a small part of the flow claimed for it, and that it would cost at least 50% more than the $3,500,000 which was stated to be its cost by its promoters. Following a popular vote at the November election in favor of a $3,500,000 bond issue for channel widening, the council ordered the city engineer to prepare plans for a $3,500,000 channel improvement and for a 580-ft. channel improvement.

The report on this planning was rendered Jan. 15, 1917. It outlines the nature of the 580-ft. channel widening, which would extend approximately from Fifth Ave. on the Olentangy River, down the Olentangy and the joined Scioto to the municipal railroad bridge below Greenlawn Ave. No change of the bed of the stream is contemplated. The cost is estimated at $4,500,000 and the flow capacity as 100,000 sec.-ft. safe (6 ft. below levee top) and 130,000 sec.-ft. at the calamity point. The city engineer recommends that in view of the 140,000 sec.-ft. flow of the 1913 flood, spillways in the levees be provided at proper points to permit water in excess of the channel capacity to pass over the top and submerge the low lands without washing out the levees, by this means providing for an additional flow of about 10%.

The $3,500,000 plan would include widening and improving the existing channel of the Scioto from the confluence south to Greenlawn Ave. The channel would have a flow capacity of 80,000 sec.-ft. safe and 105,000 sec.-ft. at the calamity point. Here also spillways for the levees should be provided at suitable points. The capacities were figured with a roughness coefficient 0.035 in Kutter's formula.

In a verbal report to council the city engineer recommended building a channel somewhat smaller than that reported on in his formal report, and in connection therewith a detaining reservoir at Dublin, on the upper Scioto, one of the two locations selected by the Franklin County Conservancy District for a dam. This dam would also furnish an auxiliary water-supply to Columbus, which soon will be short of water. The verbal recommendation was disregarded, and a week later the council adopted a resolution instructing the city engineer to go ahead with the $3,500,000 channel improvement. The first step in the work is to be the preparation of complete plans and specifications and a report on what organization and equipment is necessary for such work, together with a description of all lands that require to be taken. Mayor George J. Karb approved this resolution Jan. 23.

A peculiar feature of the situation is that under the conservancy law the still existing conservancy district has sole jurisdiction over the planning and construction of flood protection works and the like. There is a possibility, therefore, that the city's action lacks authority.

The New Rapid-Transit System of New York City, according to an announcement made by the Public Service Commission will have important portions of the system put into operation in 1917. Only six general construction contracts out of 90 remain to be let. The total amount of work on the new lines completed, under construction and under contract on Dec. 31 aggregates $196,279,000. In addition, about $15,000,000 has been spent for real estate, and the two corporations that are to operate the line have expended or let contracts for about $35,000,000 worth of work in connection with the lines which they own, besides about $20,000,000 for equipment. The lines that it is hoped to put into operation during the coming year are the Lexington Ave. line, with its Jerome Ave. extension, and a part of the Southern Boulevard extensions; the Seventh Ave. line, and possibly part of the Flatbush Ave. and Eastern Parkway subway in Brooklyn, all to be operated by the Interborough company. It is also hoped to have part and possibly all of the Broadway subway in Manhattan, to be operated by the New York Consolidated Railroad Co., in service before the end of the year.

Sanitary and Storm Sewers Combined in One Structure, Flint, Mich.

By R. E. Spear*

A design for proposed sanitary and storm trunk sewers at Flint, Mich., is shown herewith. The two sewers will be combined in one structure (Fig. 1) except where it

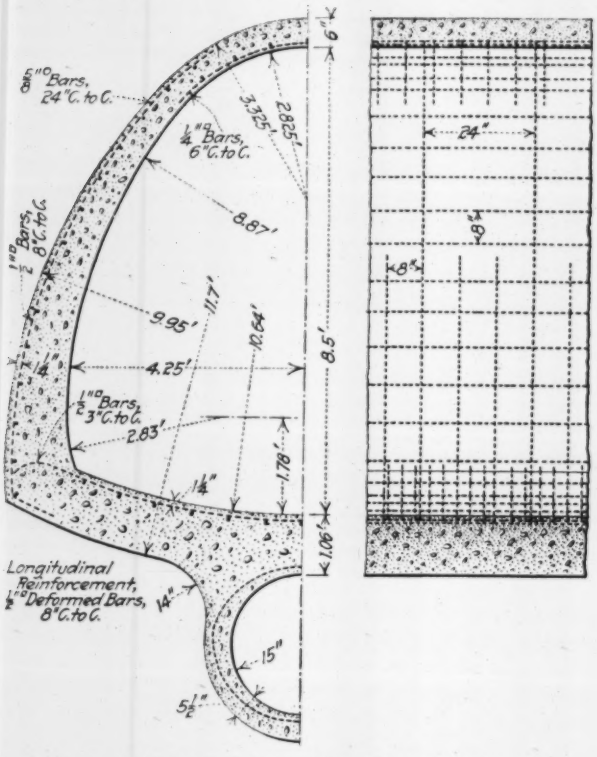


FIG. 1. CROSS-SECTION OF STORM AND SANITARY SEWERS, FLINT, MICH.

is necessary to have a manhole on the sanitary portion. At such intervals the following methods are used:

On a tangent a double reverse curve of 100-ft. radius is made in the storm-sewer portion only, thus separating

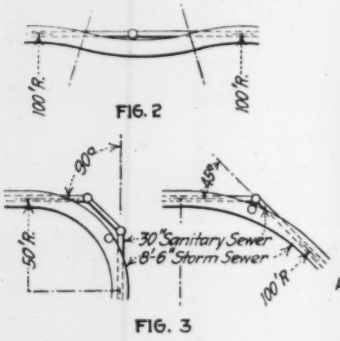


FIG. 2

FIG. 3

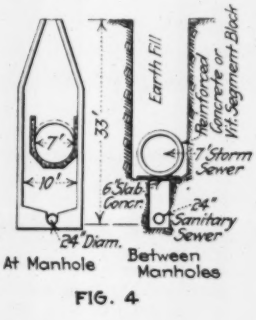


FIG. 4

FIGS. 2 TO 4. DETAILS OF STORM AND SANITARY SEWERS, FLINT, MICH.

in plan the two sewers a sufficient distance to permit the building of a manhole over the sanitary sewer (Fig. 2).

At all angles in the alignment of the sewer a simple curve of 50-ft. radius is made in the storm-sewer portion only. The sanitary sewer is carried a sufficient distance beyond the P.C. and P.T. of the storm sewer to permit the building of two manholes on the sanitary sewer in case the deflection angle of the sewer line is between 45° and 90°, and one manhole in case the deflection angle is 45° or less (Fig. 3).

Fig. 4 illustrates the type of construction proposed for that portion of the trunk line in which it becomes necessary to separate in profile the two sewers. The maximum depth of sewer is 33 ft., and the minimum depth is 15 ft.; the approximate cost is $400,000.

At the time this sewer was designed Ezra C. Shoecraft was city engineer, and W. R. Drury was assistant engineer. The writer was ably assisted by H. E. Miller, University of Michigan, 1916.

*Engineer on sewer design, Flint, Mich.

Impact Test of the Efficacy of Sand Cushions in Brick Pavements*

By Prevost Hubbard†

Many conflicting opinions have been expressed by various engineers as to the relative merits of the monolithic and sand cushion types of brick pavements as well as cement grout and bituminous joint fillers for brick. While these opinions have undoubtedly been based upon personal observation or experience, very little definite data have been presented upon the subject other than that included in certain generalities.

It was felt that information of some value might be obtained by conducting certain physical tests upon sections of brick pavements constructed in the laboratory. Upon the suggestion of C. H. Moorefield, a series of laboratory tests was therefore started a few months ago in the United States Office of Public Roads and Rural Engineering. To date these tests, which should only be considered as preliminary, have developed a few facts which appear to be of sufficient interest to warrant presentation.

Because it could most readily be made, and also because it gave promise of developing facts of most interest, an impact test was decided upon for preliminary investigations. The large Page impact machine of the office was made available for testing sufficiently large sections of pavement by inserting a flanged section under the main supporting column so that the plunger could be raised high enough to place beneath it a test specimen ten or more inches in thickness.

The sections of pavement for test were constructed in a rectangular bottomless box mold or frame made of ⅜-in. boiler plate. This frame was sufficiently deep to allow for a 6-in. concrete foundation and 1-in. cushion in addition to the paving brick. Allowing for joints, the area of the test section was that of six bricks arranged in three rows with two whole bricks on the outside rows and a whole brick in the center, flanked by two half bricks.

For all tests here reported a 1:3:6 concrete base was cast in the frame and allowed to age for at least 7 days before testing. Upon the base the brick were set in some cases upon a 1-in. or 2-in. compacted sand cushion, and in other cases upon a 1:3 cement mortar cushion

*Discussion at the road meeting of the American Society of Civil Engineers, Jan. 17, 1917.

†Chemical Engineer, United States Office of Public Roads and Rural Engineering, Washington, D. C.

spread dry upon the green concrete. Some sections were grouted with a heated bituminous filler.

Tests were made by placing the entire specimen in the frame upon the anvil of the impact machine, so that the plunger rested upon the center of the upper surface of the center brick. The blow of a 10-kg. hammer was then delivered in increasing increments of 5 cm. drop. The rebound of the hammer was measured for each blow and the height of that blow which caused failure was noted, together with any particular conditions of interest which developed in the specimen during test.

In these tests two lots of paving brick, repressed, and wire cut lug, were obtained from a brick manufacturer with a request that at the plant each lot be selected with a view to including as uniform brick as possible. When subjected to the rattler test, however, there was found to be considerable variation in the loss of individual brick although the average was low, as shown in Table 1.

TABLE 1. TESTS OF REPRESSED AND WIRE-CUT-LUG PAVING BRICK

Rattler Test:	Repressed	Wire Cut Lug
Minimum per cent. loss	14.2	13.7
Maximum per cent. loss	20.2	24.2
Average per cent. loss	17.2	17.8
Toughness Test (10 Kg. Hammer):		
Minimum blow, centimeters	46	40
Maximum blow, centimeters	60	50
Average	51	45

From this table it is also evident that considerable variation exists in the resistance to impact offered by individual brick, the toughness values given being the results obtained by testing eight individual brick of each type. The cement and aggregate used in the preparation of the concrete, mortar cushion and grout met the usual test requirements.

The results of tests upon sections of pavement constructed with the repressed brick are shown in Table 2.

TABLE 2. TESTS OF PAVEMENT SECTIONS OF REPRESSED BRICK

Filler	Cement Grout						Bituminous
Cushion	1-In Mortar			2-In. Sand		1-In. Sand	1-In. Sand
Age of Grout	7 Da.	14 Da.	28 Da.	7 Da.	28 Da.	28 Da.	2 Da.
Maximum blow, cm.	80	90	95	80	95	80	90
Grout cracked at cm.	70		80	40	40	40	No
Maximum rebound, cm.	23	26	25	7	10	8	5
Base cracked	Yes	Yes	Yes	No	No	No	No
Brick left base	Yes	Yes	Yes	...	...	...	...

Check tests were made in a number of cases and found to run close together. Where such checks were made the average results are given in the table.

Upon comparing these results it will be seen that the following facts are indicated, if not conclusively proved:

1. As compared with a sand cushion the monolithic type of construction does not protect the brick from the effect of impact but does tend to increase the resistance to impact of the grout filler when the blow is delivered on the brick. In the monolithic structure there is therefore less tendency for the grout filler to separate from the brick, although failure of the grout may be expected to occur before a general failure of the brick.

2. In the monolithic structure failure of the brick under impact resulted in failure of the entire structure, including the foundation, while with a sand cushion no failure in the foundation occurred under the impact which caused failure of the brick. This fact seems to throw into question the recommendation frequently made of employing a thinner foundation for the so-called monolithic type of construction.

3. The capacity of the monolithic pavement for absorbing the shocks of impact is less than where a sand cushion is used.

4. There seems to be no great difference in effect between a 1-in. and a 2-in. sand cushion. When the grout failed, however, there appeared to be a greater vertical displacement of the center brick on the 2-in. cushion than on the 1-in. cushion.

5. The bituminous filler protects the brick from the effect of impact fully as much as the cement-grout filler and does not itself fail even when the brick fails under impact. It should be noted that no apparent vertical displacement of the brick occurred where the bituminous filler was used.

6. As compared with cement grout the bituminous filler apparently increases the capacity of the sand cushion pavement for absorbing the shock of impact.

7. In comparison with the results of impact tests upon individual brick it is of interest to note that in the pavement this resistance is almost doubled, irrespective of the type of filler.

A few tests have been made upon wire-cut-lug block sections of pavement with results quite similar to those given above. It is proposed to continue this investigation with various makes of brick and to use other types of filler and cushion such as bituminous grout or mortar.

Belgian Relief Work Organized by an American Engineer

Every member of the engineering profession in the United States ought to be proud that the great work of saving the people of Belgium from starvation was organized and has been carried out under the direction of an American engineer. The story is not new, of course, but probably few engineers realize the magnitude of the task that has been accomplished by the organization headed by a member of their profession.

In the *Engineering and Mining Journal* of Jan. 20, W. L. Honnold, who is in charge of the American office of the Belgian Relief Commission, describes how, after the conquest of Belgium by Germany in the fall of 1914, its people were face to face with famine. Belgium is the most densely populated country in Europe and produces within its own borders less than one-third of the food it consumes. Imports were stopped, commerce was paralyzed, and under the sudden wrench of military occupation the Belgian people were unable to do anything for themselves. A few resident Americans and leading citizens organized an emergency committee. The support of the American and Spanish ministers to Belgium was enlisted. Assurances were obtained from the British and German Governments that a commission organized under neutral control might import and distribute food to the Belgian people.

The American ambassador to Great Britain, Walter H. Page, was asked to nominate a man to head the commission and named Herbert C. Hoover. Mr. Hoover is a native of Iowa, who graduated in mining engineering from the University of California in 1895 and has by his own ability as an engineer and executive attained a leading position in connection with mining enterprises in China, Australia and other countries. He has long been recognized in Great Britain as one of the leading mining engineers of the world.

An American relief committee, in which Mr. Hoover was prominent, had been organized at the outbreak of the war to aid in the work of sending home the thousands

of American citizens stranded in Europe at that time. With this reorganized committee as a nucleus, Mr. Hoover set about the gigantic work of providing food for starving Belgium. The first money obtained was raised by private subscriptions. It soon became evident that the task was so huge as to exceed any possibilities of financing by private contributions alone. Mr. Hoover went personally to the Government officials of Great Britain and France and secured from each of these countries a monthly contribution of $2,500,000 for the work of the commission. From certain French institutions $4,000,000 per month was later received, and this enabled the commission to help those requiring relief in the war-swept portions of France. With these sums have been combined the private contributions obtained from all parts of the world, but still the amount has been insufficient to meet the need. As a result of a further appeal to the Governments concerned, England last year doubled her monthly contribution and France has added 40% to its subscription for the relief of the inhabitants of northern France. These increases, however, still leave the commission short some $3,000,000 per month of the sum required to provide the people of Belgium with what is considered a minimum living ration. How serious the condition is may be judged by stating that even if this extra $3,000,000 were available, the rations to the destitute Belgians would be less by one-fifth than that given by the Germans to their prisoners of war.

Some idea of the magnitude of the work which the Relief Commission has carried out may be given by figures. On Oct. 31 last, the commission had imported into Belgium 2,190,000 tons of food, at a cost of $173,658,000, while over $28,000,000 was in transit. This food had been brought by 356 transatlantic ships and 763 cross-channel ships and had been transported into the interior of Belgium by 5913 canal lighters.

The task of purchasing, transporting and distributing this vast amount of material, supplying the necessities of life for over 7,000,000 people in Belgium and 2,250,000 people in northern France, requires a large organization, and it has to carry on its work with careful regard to the restrictions imposed by the various Governments involved.

Through the efforts of Mr. Hoover and his associates, coöperation, financial assistance and reduction in rates have been secured from a large proportion of those who are carrying on the commission's work. Most of the department heads of the commission and many of the assistants also are volunteers who give their services either gratis or for only their living expenses. The efficiency with which this vast work has been carried on is indicated by the statement that the overhead expense of handling this enormous business, including that incurred by all the Commissions' offices in Belgium and in foreign countries, has averaged only 5/8 of 1%.

Those who threw themselves heart and soul into this enormous task when the emergency came, nearly three years ago, had no idea, of course, at that time of its long duration. Some months ago the commission proposed to relinquish the work and turn over the task to the people of Belgium. The Governments concerned, however, declared that in order that the work should continue it must remain in neutral hands. In an address last May by the British prime minister, Mr. Asquith, he referred to Mr. Hoover's work as a miracle of scientific organization and continued:

Mr. Hoover and those associated with him have had to provide and are providing every day food for over 9,000,000 persons. I desire to express on behalf of the Government our deep gratitude to Mr. Hoover and to those American citizens who have so nobly given up their time and their occupations, without recompense and to a large extent without recognition, to this work of purchasing, shipping and distributing the supplies which alone enable the population of Belgium to keep body and soul together. It is one of the finest achievements in the history of humane and philanthropic organization.

Mr. Hoover, who arrived in New York on Jan. 20, is appealing to the American people for additional contributions, to the amount of $1,000,000 per month, so that a little more food may be given to the school children of Belgium. The commission has had thorough investigations made by Dr. William C. Lucas, of the University of California. He reports that the effects of the scanty food allowance on the Belgian people are chiefly evident in an alarming reduction of vitality and increase in tuberculosis and similar diseases among the children of school age. The commission estimates that to counteract this undermining of the health of the coming generation it must spend about $1 per month for each child, or $1,000,000 per month for the 1,000,000 children who need extra sustenance. To aid in raising the funds required for this work, American engineers and others willing to contribute are asked to subscribe to the stock of "Belgium Kiddies, Ltd." The stock is issued at $12 a share, and every purchaser of the stock is sure of a dividend return in the consciousness that for every share of stock that he buys an under-nourished Belgian child will receive one badly needed meal a day for a whole year. Contributions may be sent to the Belgian Relief Commission, 120 Broadway, New York City.

There is a prevalent impression that the United States has been a liberal contributor to the relief of Belgium. The fact is that the total contributions from the United States amount to only 8c. per capita of her population. In contrast to this, Canada has contributed 18c.; Australia, $1.23; New Zealand, $1.98; and Tasmania, $6.53 per capita for Belgium relief. These countries which have contributed with such generosity compared with the United States are countries whose people are suffering all the losses and extra demands which come as a consequence of being engaged in the war. The United States, on the other hand, of all countries in the world has had a prosperity as a result of the war such as was never known. Moreover, nearly all of the $200,000,000 which the commission has expended in buying food has been spent in the United States.

This is a great work for humanity, organized and carried on by American engineers who are themselves devoting their time and ability without thought of recompense.

Mr. Hoover and his associates have done more in the past two years to bring honor and credit to the United States among the peoples of Europe than any other Americans. They surely deserve and ought to receive in their great work the financial support of their countrymen.

Water-Supply Difficulties—Fort Scott, Kan., has been short of water since August, 1916. To help out the supply it has dug ditches connecting pools over a course of 30 mi. in the Marmaton River. The authorities expect to construct additional dams in the river to impound water. As far back as 1913 the people voted $32,000 for a filter plant, but at the same election the officials who had favored the plant were defeated for reëlection, and as a consequence the appropriation has never been expended.

News of the Engineering World

Mount Royal Tunnel Nearly Finished

It was recently reported in Montreal that the Mount Royal tunnel of the Canadian Northern Ry., under the City of Montreal, is very near completion and that the permanent tracks are now being laid. Work had been practically stopped for a year because of the war. It is expected that, in June, the regular trains of the railroad will be running through to a temporary city station that is to cost about $150,000. Two of the six locomotives first ordered have been delivered by the General Electric Co. and will be used on construction. The substation equipment has been installed.

St. Louis Municipal Bridge Opened

The completion and opening of the highway deck of the St. Louis Municipal Bridge across the Mississippi River, was the occasion for a general municipal celebration in St. Louis on Jan. 20.

A huge chain was stretched across the roadway at each end of the bridge and each of the chains was fastened by a unique padlock made in the blacksmith shops of the city organization engaged in the bridge construction.

The President of the Board of Public Service presented the key to the Mayor of St. Louis, who opened the lock and admitted the crowd to the bridge. The Mayor afterward took the lock to the center of the bridge and threw it over into the Mississippi River, thus symbolizing the removal of all impediments to free access from St. Louis to East St. Louis.

The bridge is double decked, the lower deck being for steam-railway traffic, the upper one for foot, automobile, wagon and electric-railway traffic. The bridge with highway approaches is 9797 ft. long, and with its railway approaches 18,258 ft. The channel span is 2022 ft. From the highway deck to the low water mark the distance is 143 ft.; from the railway deck 115 ft. The clearance is 65 ft.

New Governor's Recommendations for New Jersey Highway Reform

The new governor of New Jersey, Walter E. Edge, who was inaugurated Jan. 16, has propounded some different theories than those recommended by the special commission appointed by former Governor Fielder, an abstract of whose report was published in *Engineering News* of last week. In his inaugural address Governor Edge states that he "believes in a thorough reorganization of the road department, including the establishment of a modern highway system." He said that the $7,000,000 provided for in the recent bond election would not under any conditions be sufficient to build the highways specified and that the act was impracticable, if not absolutely impossible.

The new governor recommends that funds for new state highways be provided by a temporary state tax on all ratables. He would reorganize the highway department by creating an unpaid highway commission of eight members, three of whom would be engineers, which would have the power of appointing a state highway commissioner or highway engineer. He advocated liberal state aid for the improvement of township earth roads and the universal adoption of the patrol system of road maintenance, even to the extent of refusing state aid for any county improvement where the patrol system of maintenance was not provided.

San Francisco Loses Incinerator Suit

The suit of the Destructor Co., of New York City, to recover $160,000 from the City of San Francisco for the construction of the Islais Creek incinerator and a portion of the equipment of the North Beach incinerator was decided Jan. 18 in favor of the Destructor Co. in the Federal District Court. According to City Engineer M. M. O'Shaughnessy, an immediate appeal will be taken from the decision and the case will be carried, if necessary, to the highest tribunal.

The contract for two incinerators of 120 tons capacity at a total of $255,000 each was awarded on Nov. 28, 1910, under specifications drawn with Rudolph Hering, New York City, as consulting engineer, and Marsden Manson as city engineer. Soon after Mr. O'Shaughnessy became city engineer he examined incinerators in the East and concluded that the Destructor Co. would not be able to comply with its contract on account of the heavy moisture content of the San Francisco refuse—50%. He ordered construction on the North Beach incinerator discontinued until the Islais Creek plant had been completed and tested. On the basis of tests made late in 1914, Mr. O'Shaughnessy advised the rejection of the plant on the grounds that it did not comply with the specifications, inasmuch as a nuisance was created in its operation and that obnoxious odors, smoke and dust escaped from the building or the chimney. The company brought suit, as stated above. (See *Engineering News*, Nov. 26, 1914, p. 1096 and Dec. 10, 1914, p. 1190.)

River des Peres Preliminary Plan Approved at St. Louis

The Board of Public Service of St. Louis has adopted a preliminary report and plan for the improvement of the River des Peres in that city, prepared by the Division of Engineering Design under the direction of W. W. Horner, Chief Engineer. Money for the improvement has not yet been provided.

The River des Peres is an open stream running through the City of St. Louis for about 18 mi. It has a drainage area of about 70,000 acres, three-fourths of which is outside the city.

The city has constructed many sewers discharging into this stream and the stream itself is now a serious nuisance in dry weather and its floods, which have become more

serious each year, have caused an enormous amount of damage.

The preliminary plans provide for completely inclosing the stream in reinforced-concrete sewers for about 4 mi. and for constructing a large open channel with sloping banks and lined with reinforced concrete for a distance of about 9 mi. This plan decreases the length of the stream approximately 5½ mi. The largest sized reinforced-concrete sewer proposed will consist of twin arches each 29 ft. wide and about 24 ft. high. The estimated cost of the project is $6,700,000 in addition to approximately $1,000,000, which has already been spent on partially completing a sanitary intercepting sewer along the route of that portion of the improvement on which the storm water will be carried in an open channel.

The outlet of the drainage scheme is into the Mississippi River and the report contains the interesting study of the probabilities of the stages in the Mississippi River against which the channel will discharge as compared to the probable occurrence of intense precipitation.

Another interesting feature is the high rate of runoff provided in the design. This rate varies from 0.72 cu.ft. per sec. per acre at the outlet to as high as 1.10 cu.ft. per sec. per acre at a point about 12 mi. from the outlet. In determining the rates of runoff, the report contains a prediction of the rate and growth of population in the now rural areas and sets values on the rates of runoffs from such areas by districts.

The whole design is based on the rational method of determining runoff as now commonly used in sewer design but is probably the largest project to which this method has been applied.

American Wood Preservers' Association Discusses Wood-Block Paving

A half-day's session of the annual meeting of the American Wood Preservers' Association, held in New York City, Jan. 23 to 25, was given over to a discussion of wood-block paving. A committee report on service tests of wood-block pavements gave data of value on the history of existing pavements as old as 19 years.

The regular committee on wood-block paving reported the specifications adopted by the joint committee, which met in Brooklyn, N. Y., in September, 1916. These joint-committee specifications have already been accepted by the American Society of Municipal Improvements and were accepted as a part of the progress report of the Road Materials Committee by the American Society of Civil Engineers at the recent annual meeting.

These specifications are practically the same as those drawn by the committee of the American Wood Preservers' Association and submitted at the 1916 annual meeting. This committee differs from the opinion of the joint committee concerning the method of computing the absorption of the preservative, and it does not approve the use of sand filler or sand cushion.

The committee expressed the opinion that, if the new specifications were carefully followed, the resulting street would not bleed excessively, nor should there be serious expansion troubles. The method of forcing in the oil should give the maximum penetration obtainable with the absorption used. These specifications require from 25 to 50% more time than is commonly required for creosoting blocks, but it was felt that the possibility of increasing durability and lessening expansion and bleeding troubles warranted this. From 10 to 12 hr. is required to treat properly Southern pine blocks by the new specifications.

The European practice of laying the blocks directly on a smooth concrete base was commended, particularly that method in which the blocks are either dipped in pitch immediately before laying or where they are set in hot pitch swabbed upon the concrete base. Recent examination of some old pavements so constructed furnished the most convincing argument in favor of that method. Where this type of construction has been abandoned, it has been done solely on account of the fact that it was thought possible to reduce the cost of construction without detrimental effect. The increased cost has been the chief obstacle to its more general adoption.

Within the last two years a new method has been introduced, which the committee believes to be of great importance to the future of the industry. It consists simply in coating the smoothly finished concrete base with bituminous cement and allowing this to get cold and harden before attempting to set the blocks on it. The expedient of allowing cement first to cool and harden before setting the blocks removes the objection of high cost and also removes the objection in regard to the difficulty of replacing faulty blocks. Furthermore, it accomplishes the same results as if the blocks had actually been set while the pitch was still hot, as it is found that after a day or so the blocks all adhere firmly to the base.

A fight was made by several manufacturers against the preliminary steaming of both air-seasoned and green timber, which is the distinguishing feature of the new specifications. It was contended that the two to four hours of preliminary steaming was not only unnecessary in the case of air-seasoned timber, but was an actual detriment as well as a useless expense. The committee defended the steam-treatment clause of the specifications as necessary to obtain a thorough distribution of the preservative and to swell the blocks to their normal size. The fact was emphasized that in treating wood paving blocks special conditions were to be met and that this must be done by special methods which would not apply to timber preservation in general. The preliminary steaming treatment was claimed to be the chief means of curing both bleeding and expansion troubles. After considerable debate the committee won its contention, and the report was adopted.

Canadian Engineers' Society Looking to Its Internal Development

A marked movement in the Canadian Society of Civil Engineers was manifested at the annual meeting in Montreal, Jan. 23 to 25, for the internal development of the society to increase its benefits to members and its outside influence.

The valedictory address of the retiring president, G. H. Duggan, was devoted to this. He referred to the numerous complaints of members who were not satisfied that everything possible was being done. First, he presented statistics of the distribution and growth of membership since the society's formation, to show that Montreal was still the most central location for headquarters. He recommended finding some means of keeping distant members in touch with society activities and making them

for a share of directing the work. To this end, he suggested (1) more frequent meetings of the council and more certain district representation; and (2) quicker printing of papers and publication of a monthly bulletin. Better service would require more funds, and he suggested a considerable increase in the fees of members resident near headquarters, a small increase to associate members, but no increase for juniors or students. More publicity was recommended as calculated to extend the influence of the society, so that the value of engineering advice would be wider recognized. Such efforts were commended as those of the Montreal member ratepayers who had reported on the local aqueduct-power scheme (as noted in *Engineering News*, Nov. 30, 1916).

A special Committee on Society Affairs (composed of three members from each outlying district and six from headquarters, and asked for by the last annual meeting to bring in recommendations for internal improvements) made a progress report in which several propositions were placed before the annual meeting. Of these the following were adopted and will go into effect through the regular machinery:

(1) The inclusion in the list of members of a geographical distribution by districts; (2) the creation of a new class of membership to be known as "retired members," who shall be over 65 years of age and have been corporate members for over 20 years, the annual fees for them being nominal; (3) the publication of a monthly journal; (4) the elimination of interest charges on annual dues for the first six months of the current year and a fixed charge of 50c. for each six months' period thereafter; (5) systematic publicity in the public press; (6) a systematic effort to have recognized university engineering professors identified with the society and to secure coöperation of universities; (7) the engagement as soon as practicable of a secretary who will devote his whole time to the society; (8) the election of the nominating committee and of the council by districts; (9) the encouragement of more general use of the society's standard specifications; (10) the redrafting of the entire bylaws; (11) the systematic collection and filing of the important engineering reports of Canada, Great Britain, France and the United States; (12) the appointment of a committee to take cognizance of and report upon all public questions of legislation which may appear to be contrary to sound engineering practice or to the interest of members; (13) the obtaining of annual grants from Dominion and provincial governments.

The proposition to change the name to "Canadian Institution of Civil Engineers" or "Canadian Institution of Engineers" was debated, but no action was taken. The meeting approved the council's stand for the limitation of employment of alien engineers and for closer attention to expulsion of undesirable members.

The report of the Finance Committee showed total receipts for the year 1916 of $23,727 and total expenditures of $20,085. The total receipts were about $1000 in excess of the next highest year (1912), due to the better collection of arrears. This good showing was made in spite of the fact that there were 678 members in war service.

Technical-Committee Reports

The Committee on Roads and Pavements brought in specifications for crushed stone, gravel and sand for road-work, which were adopted as the recommended specifications of the society. The committee is still collecting data on the construction of pavements throughout the Dominion and is engaged in drafting specifications for the supply of bituminous materials.

The Committee on Steel Bridge Specifications reported the preparation of a draft of specifications for highway bridges, which specifications are to be sent out to branches for comment or approval as one step in the preparation of standard specifications of the society.

The Committee on Sewage Disposal and Sanitation recounted its efforts to have provincial boards of health require engineers' approval of plans for sewage works, but reported that it had not been able to accomplish much.

The various committees were continued (including those on conservation, education, concrete, and steam-boiler specifications), the Steel Bridge Committee being empowered to add to its number representatives of the various districts, and the Committee on General Clauses being asked to reorganize for the completion of its work. A new committee was asked for—one on portland-cement specifications.

J. S. Dennis, Assistant to the President, Canadian Pacific Ry., was elected President; J. M. R. Fairbairn, Assistant Chief Engineer, Canadian Pacific Ry., and C. N. Monsarrat, Chairman, Board of Engineers, Quebec Bridge, were elected Vice-Presidents.

Illinois Engineers Widen Activities

The two most prominent features of the annual meeting of the Illinois Society of Engineers were the decisions to extend the scope of the Society by coöperation and affiliation with semi-technical and nontechnical persons and associations, and to organize sections dealing with individual branches of engineering work. Thus the affiliated membership will provide for association with lawyers, contractors, municipal officers and others who are interested in and closely related to engineering matters. The sections will include both the engineer members and the affiliated members in such lines of work as land drainage, good-roads promotion and management of municipal engineering properties. Further than this, the Society will seek active coöperation with various technical and promotional organizations, such as local engineering clubs, good roads associations and city-planning commissions.

In the more technical part of the proceedings it is of interest to note the particular attention devoted to the need of engineering advice in the small towns. This point of view was dealt with in three papers written independently and covering different subjects. Although the individual engineering works in such towns are relatively small, they are of importance to the community and in the aggregate they represent considerable professional and financial importance. Thus the Water-Supply Committee stated that about 90% of the new water-works built in Illinois during the past three years have been in places of less than 2000 population. In such cases the supply and distribution systems are planned largely by local committees, and engineering advice is at a minimum. The report showed the economic advantages of engineering advice in regard to both the design and construction of these small water systems.

Maintenance of engineering works in these small towns is largely neglected, and the report above noted suggested the economy of employing engineers to make semi-annual inspections of the water-supply systems. On the same lines, papers by M. H. Brightman (city engineer of Elgin) and F. C. Lohman (city engineer of Champaign) suggested the wisdom of making the necessary expenditure for proper inspection and maintenance of sewerage systems and street paving, and for competent control of the operation of sewage-disposal plants.

A subject of rather special character was "Engineering Ethics and Engineers' Fees," the matter of fees receiving

the larger share of attention. E. E. R. Tratman (*Engineering News*) remarked that in this respect the practicing engineer is rather in a dilemma. On one hand he has to consider the advisability and possibility of obtaining larger fees, and on the other hand he has to consider the demands for higher pay for his engineering assistants. The question of engineering professors undertaking private practice was touched upon, and the report pointed out that this was unobjectionable if subject to proper curb by the university or college authorities, and if the charges made are approximately the same as those of practicing engineers.

The Illinois structural engineers' license law was reviewed in one of the reports, which showed the interesting fact that while the legislature passed the bill it failed to make an appropriation for the expenses of the board of examiners. The members of the board were public-spirited enough to do the work and pay their own expenses until conditions were relieved, while the Western Society of Engineers gave the use of its rooms and staff. The first examination under this law was held at the University of Illinois in October, 1916.

The election of officers for 1917 resulted as follows: President, W. D. Gerber (Chicago); Vice-President, J. G. Melluish (Bloomington, Ill.). The next meeting will be held at Quincy, Ill., in 1918.

National Foreign Trade Convention

The fourth annual convention of American manufacturers and merchants interested in foreign trade was held at Pittsburgh, Jan. 25 and 27, and was attended by about 1200 delegates from all parts of the United States. A special train brought over 100 from the Pacific Coast. The most important topic considered was the condition of world trade after the war; and there was general agreement that the United States will have to play a leading part in the restoration of Europe and that this will create a great demand for American goods abroad for some years to come.

It was urged that in carrying on this trade, American business men should practice such fair dealing and cultivate such friendly relations with their customers abroad that they may be able to continue to do business there after the urgent stress has passed. In order that this American export trade shall continue, however, it is absolutely necessary that American investors shall be willing to purchase foreign securities. Eventually, of course, the imports of the United States must approach its exports in value, for there is not gold enough in existence to permit for any long time the payment in gold for such a vast surplus of American exports as has gone abroad this year. It will be years, however, before Europe will be in condition to send imports to the United States in such volume as in the past; and during this period the international trade balances must be largely settled by loans from American investors to European governments or their purchase of the securities of foreign corporations.

Coöperation in foreign trade by associations of manufacturers was discussed at much length. While coöperation is to some extent dependent on the passage of the Webb bill, now before Congress, it developed that a great deal of coöperative work is now being done.

An evening session was held to discuss commercial education for foreign trade. The most effective work of this sort appears to be done by the schools for training men now in business, rather than by special courses in high schools and colleges. In order to reach the efficiency of the Germans in this field, however, young men must be given a thorough training in the language, history and customs of a particular country and must go there to make it their permanent home. There is at present a great scarcity of men experienced in foreign trade and the further development of American export business is limited by this lack.

The need of developing an American merchant marine was emphasized by the devotion of one entire session of the Congress to this subject. At present the shipping business is prosperous as never before. Of the 50,000,000 tons of merchant shipping of all nations existing at the outset of the war, only about half is now available for use. Casualties of the war and the sea, taking of merchant vessels for government service and interning of vessels carrying the flags of the Central Powers account for the other half. Opinions differ as to how short the carrying capacity of the world's merchant marine will be at the end of the war, because no one knows how much traffic will be then offered for transport. The judgment of experts, however, is that there will be a shortage of 5,000,000 to 10,000,000 tons and it will take the shipyards of the world several years to restore the world's merchant fleets to normal size.

At present anyone can run ships at a profit. Eventually world-wide competition will reduce ship earnings to the low rate that existed before the war; and unless the United States vessel can be operated as cheaply as the ships under foreign flags, the shipping industry must have some form of government aid or the American flag will again disappear from the seas. The task of the newly appointed U. S. Shipping Board is to find the best plan for this country to adopt to restore its merchant marine.

Water and Street Transportation in Conflict at Pittsburgh

The citizens of Pittsburgh were aroused last week over the question whether the city should be compelled to rebuild its bridges over the Allegheny River so as to afford a greater clearance for navigation. Secretary of War Baker announced that arguments on the question must close by Jan. 29. The Citizens Anti-Bridge Raising Organization conducted a whirlwind campaign to secure signatures protesting against the enforced raising of the bridges. The Board of Directors of the Pittsburgh Chamber of Commerce voted unanimously to oppose the raising of the bridges, and this action was indorsed at a special meeting of the chamber by a vote of 293 to 66.

The ground for the local protest is, first, the expense involved, variously estimated at $3,000,000 to $12,000,000; and second, the permanent burden on the enormous traffic passing over the bridges, due to requiring every pound of weight to be lifted 10 to 20 ft. higher to pass over the bridges after raising, together with the difficulties involved in steeper grades on the approaches.

If the comparison is between the traffic over these bridges and the present traffic on the river under them, then the raising of the bridges could not be justified, for the present traffic on the Allegheny is insignificant. There is, however, some reason to believe that the rivers

at Pittsburgh may in future play a more important part in commerce than they have ever done. The congestion on the railways in the Pittsburgh district is very serious. Yards and terminals are crowded to capacity; real estate is too costly to permit of much enlargement. There is some reason to believe that the rivers may be made use of more largely to distribute coal, coke, ore, etc., within the district and would be valuable in the relief they would afford to the congestion on the railway lines to an extent not measured by the amount of tonnage handled.

To develop this traffic, however, alterations in the bridges are necessary, for some of the bridges that are near each other have their piers so staggered that a boat passing between the piers on one bridge is headed straight for the piers of the bridge below. If a bridge must be rebuilt to bring its piers in proper position, it might as well be placed at a proper elevation.

It is admitted that the former proposal that the bridges should be raised to give a clear height of 45 to 50 ft. was not justified, for it has been proved possible to build satisfactory stern-wheel towboats with a height of 28 ft., and the bridges ought not to be made higher than necessary, on account of the burden placed on the traffic over them. That authority rests in the Federal Government to order the bridge alterations solely with regard to the convenience of navigation is undoubted; but the strict legal view that the traffic over a waterway must always yield to the demands of the navigator of the waterway, because he has prior rights of use, is not insisted on now as much as formerly.

It seems probable that the best solution of the Pittsburgh dispute may be found in a compromise. That the present bridge piers are an obstruction to navigation is admitted even by the opponents of bridge raising. It ought to be possible to work out a program that would provide reasonable facilities for developing navigation on the Allegheny, without imposing undue hardships on the traffic and the taxpayers of Pittsburgh.

Worcester Sewage-Works Enlargement

Pressure is being brought on Worcester, Mass., to enlarge and alter its sewage-treatment works so as to discharge less polluting matter into the Blackstone River. The movement seems to have been started by an application to the State Department of Health to permit the sewage from the Worcester Insane Hospital to be discharged through the sewers of the City of Worcester. An investigation of the Worcester sewage-works led the department to ask the city authorities why the department should not order the immediate construction of works which would treat the sewage to the satisfaction of the department. It was intimated that works along the line of Imhoff tank experiments the city had been conducting for some time would be satisfactory. The city authorities plead for an opportunity to carry further some activated-sludge tests under way. The State Department has granted a limited time for this purpose, but has filed with the Legislature a report, now in the hands of the State Printer, recommending the authorization of bonds for the construction of adequate sewage-works. Representatives down the Blackstone River have introduced two or more bills designed to force action. One of these requires that the sewage of Worcester must be treated to a satisfactory degree and that when the removal of organic matter, as indicated by albuminoid ammonia, falls below 90% unnecessary pollution shall be considered to exist.

Dumping Goods on American Market

There has been a great deal said about the danger of European manufacturers "dumping" low-priced products on the American market as soon as the war closes. W. W. Nichols, Chairman of the American Commission, in his address at the National Foreign Trade Convention at Pittsburgh last week said: "There are many reasons why dumping low-cost products into our markets appears not only improbable, but impossible for many years to come." He closed his address with a most significant revelation, possibly prophetic of the coming of a better era in international relations:

> Added to the warm sympathy unanimously accorded our mission by the great minds of France, Lloyd George, who is accepted as the practical dictator of British affairs and probably therefore in a large sense the exponent of the best British opinion, expressed the desire that what we hoped to do with France might likewise be done not only with Great Britain, but even with the Central Powers after the settlement of present "differences," for, as he magnanimously asserted, "the world is big enough for all of us."

Detroit Needs $16,000,000 of Sewerage improvements, including $10,000,000 at once for sewers in 31 sq.mi. of annexed territory and $6,000,000 for sewage-treatment works which can wait a few years, says Clarence W. Hubbell, the new City Engineer. An attempt is to be made to get the money for the sewers at once.

The New Colorado River Intake Gate for the main canal of the Imperial Irrigation District ("Engineering News," Jan. 18, 1917, p. 124) will be built by the Ross Construction Co., of Sacramento, Calif. The contract price is $268,000. C. K. Clarke, Calexico, Calif., is chief engineer of the Imperial Irrigation District.

Free Engineering Services to Minnesota municipalities are requested in the resolution of the League of Minnesota Municipalities adopted at its meeting, Oct. 19, 1916, which recommends that "steps be taken to have an engineer of maturity and wide experience in municipal work added to the faculty of the State University Extension Department." It is reported that the Regents of the University of Minnesota have provided in the budget to be submitted to the legislature for a consulting civil engineer in the University Extension Department, whose services will be free to all Minnesota cities and towns.

Wrecking the Old Spans of the Omaha Bridge of the Union Pacific Ry. is to be done in an interesting manner. These spans now stand on timber piers alongside the new spans placed on the original piers, as described in "Engineering News," Jan. 18. A traveler, which will be installed on the top of the trusses of the new spans, will strip the floor system and the bracing between the old trusses. Then these latter trusses will be pulled over close to the new structure and supported from it, while the members are removed through the new trusses. In this way no falsework will be required under the four old spans. The work of removal will be done by the American Bridge Co.

The Million-Dollar Road Fund appropriated by Congress to assist the development of the national forests has been allotted as follows: Alaska, $46,354; Arizona, $58,604; Arkansas, $9803; California, $140,988; Colorado, $62,575; Idaho, $108,730; Montana, $70,042; Nevada, $19,296; New Mexico, $42,495; Oregon, $128,111; South Dakota, $8092; Utah, $41,167; Washington, $91,944; Wyoming, $40,684. A total of $9995 has been allotted to Florida, Michigan, Minnesota, Nebraska, North Dakota and Oklahoma. The group of Eastern states—Georgia, Maine, New Hampshire, North and South Carolina, Tennessee, Virginia and West Virginia—in which the Government is purchasing lands for national forests receives $21,120. In making allotments, 10% of the amount available for 1918 is withheld as a contingent fund. One-half of the remainder has been apportioned among the states in amounts based on the area of the national-forest lands in each state, while the other half has been allotted on a basis of the estimated value of the timber and forage resources that the forests contain.

A Chicago Subway System built by private capital is proposed by the Chicago Subway, Arcade and Traction Co. The company has introduced an ordinance granting a 30-yr. franchise for about 60 mi. of subways. Half the system would be completed in 2½ yr. and the remainder in 5 yr. The structures and equipment are to revert to the city without cost at the expiration of the franchise. Two other ordinances include a 20-yr. franchise for an outer harbor, utilizing the material excavated from the subways, and a 15-yr. franchise for warehouses and a bridge at the mouth of the Chicago River. The company has requested the City Council to have these ordinances put on the ballots at the April election.

Tunnel Workers Get Hero Award—Four tunnel workers in the West Side Water Intake Tunnel, Cleveland, Ohio, were awarded hero medals by the Carnegie Hero Fund Commission for bravery in rescue expeditions after the gas explosions in the crib heading of the tunnel on July 24. The tunnel at that time was full of afterdamp and marsh gas, and in two rescue parties ten or twelve men perished by asphyxiation. The four men who received medals went into the tunnel several times while it was in this dangerous condition, and rescued a number of members of the parties overcome in the tunnel. The names of the heroes are Thomas J. Clancy, William J. Dolan, James J. Keating, and James S. McGrath.

Radical River Straightening Plans are being worked out for the Cuyahoga River, Cleveland, Ohio, by an engineering committee that unites the principal interests concerned in previous planning. The local U. S. Engineer Officer, the county engineer, the city engineer, and the former city river and harbor engineer, are joined on the committee, which is working under the auspices of the local Chamber of Commerce. A plan has been worked out by this committee which is more radical than any previously proposed. It would make the river practically straight from the mouth to a point above the Wheeling & Lake Erie bridge, thus covering the worst-curved part of the river. It would also clear up the serious situation at the location of the proposed Lorain-Huron viaduct, where at present satisfactory pier location and bridge alignment are impossible, so that the construction of the bridge, money for which was authorized by the voters, is held up.

A Bridge Across the Hudson River at Castleton, 10 mi. south of Albany, is to be built by the New York Central & Hudson River R.R. An application for the approval of the plans for the bridge is now pending before the Secretary of War. The bridge was originally designed with spans 400 ft. long; but to meet any possible objection as to interference with navigation, the length of the channel span has been increased to 600 ft. An additional channel will be dredged by the railroad company under the 400-ft. span that forms the eastern part of the structure. The traffic of the New York Central lines is at present carried across the river at Albany on a low-level bridge, with a heavy grade from the bridge westward and another heavy grade on the eastward on the Boston & Albany road. Heavy freight trains on these grades require one and two pusher engines. The new bridge, if built, will be a high-level bridge, permitting easy grades and connections on both the east and the west shore. With the exception of the Poughkeepsie bridge, this will be the only bridge across the Hudson River south of Albany.

PERSONALS

George Freis has been appointed County Engineer of Iowa County, Iowa, with office at Morenzo, succeeding Byron Goldthwaite.

Le Roy Greenalch has resigned as City Engineer of Rensselaer, N. Y., to accept a position with the New York State engineering staff.

Clifford Goplerud has been made County Engineer of Mitchell County, Iowa, with headquarters at Osage, succeeding B. B. Hanson.

F. D. Pearse has been appointed County Engineer of Franklin County, Iowa, with headquarters at Hampton, succeeding A. G. Baker.

J. W. Mercer, formerly County Engineer of Lucas County, Iowa, has resigned to become County Engineer of Ringgold County, with headquarters at Mt. Ayr, Iowa.

T. H. Gatlin, Assistant Chief Engineer of Maintenance-of-Way of the Southern Ry., has been made Assistant to the Vice-President, with headquarters at Washington, D. C.

John N. Wilson has resigned as Assistant County Engineer of Washington County, Pennsylvania, to become Construction Engineer of the Hazel-Atlas Glass Co., Wheeling, W. Va.

Alva J. Smith, Resident Engineer on construction of the Emporia, Kan., water-purification plant has been appointed City Engineer and Superintendent of the Water Department.

B. Herman, Chief Engineer of Maintenance-of-Way of the Southern Ry., Washington, D. C., has been appointed Chief Engineer of the Lines East of Cincinnati, with headquarters at Washington.

C. E. Stone, for the past 14 years with the civil engineering department of the Pittsburgh & Lake Erie R.R. at Pittsburgh, Penn., has opened an office at 1902 Benedum-Trees Bldg., Pittsburgh, for private practice.

N. W. Storer, F. Am. Inst. E. E., General Engineer of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Penn., has been elected President of the Veteran Employees Association of the company.

William A. Cattell, M. Am. Soc. C. E., **Henry S. Howard,** M. Am. Soc. M. E., and **Raymond Ashton** announce their association under the firm name of Cattell, Howard & Ashton, Engineers, 68 Post St., San Francisco, Calif.

M. Helston, recently Superintendent of the Virginia (Minn.) division of the Duluth, Winnipeg & Pacific Ry., has been made Superintendent of the Calgary division of the Canadian Northern Ry., with office at Calgary, Alberta.

C. A. Forter, formerly Assistant City Engineer and more recently Superintendent of the municipal incinerating plant at Topeka, Kan., has entered the employ of the John Baker, Jr., Asphalt Distributing Co., Kansas City, Mo.

Curtis Dougherty, former Chief Engineer of the Cincinnati, New Orleans & Texas Pacific Ry., Cincinnati, Ohio, has been appointed Chief Engineer of the Lines West of Cincinnati of the Southern Ry., which has absorbed the C., N. O. & T. P.

C. S. Rindsfoos, President of the U. S. Purchasing Corporation, New York City, has become associated with the Jarrett-Chambers Co., Inc., Engineers and Contractors, New York. He was formerly Secretary and Treasurer of the Foundation Co.

Fred Aphüls, M. Am. Soc. M. E., **Halbert P. Hill** and **T. Harold McCreery,** M. Am. Soc. M. E., have formed the firm of Aphüls, Hill & McCreery, Inc., with offices at 112 West 42d St., New York City. The new firm will specialize in the design and construction of industrial power plants and refrigerating plants.

Henry Lindenkohl has been appointed Engineer of Construction of the American Locomotive Co., with headquarters at Schenectady, N. Y. He was born in New Jersey in 1883 and is a 1905 graduate of Stevens Institute of Technology. He has been with the American Locomotive Co. since 1905, when he was an inspector on building construction.

John J. Carty, President of the American Institute of Electrical Engineers, Chief Engineer of the American Telephone and Telegraph Co., New York City, has been commissioned Senior Major in the Signal Officers' Reserve Corps of the United States Army. This is a special distinction for it makes him the ranking officer of the Signal Corps Reserve, which is to be organized under the provisions of the National Defense Act. of June 3, 1916.

Fred Bennett, for more than four years Highway Engineer of Bexar County, Tex., of which San Antonio is the county seat, resigned his office Jan. 25 to become effective not later than Feb. 10, to become one of the members of the firm of Julian C. Feild & Co., Consulting Engineers, Denison, Tex. Mr. Bennett was associated with Julian C. Feild during 1910-11 during the building of the Denison road system, after which he went to San Antonio to become Highway Engineer for Bexar County. During his incumbency in that position he built the Bexar County highway system at a cost of slightly over $1,500,000, and since the completion of the road system has inaugurated an effective maintenance system for the county roads.

A. L. Humphrey, M. Am. Soc. M. E., First Vice-President and General Manager of the Westinghouse Air Brake Co., Pittsburgh, Penn., has been elected President of the Union Switch and Signal Co., in accordance with merger proceedings of the two companies. Hereafter he will assume the executive work of both companies. He was born in Erie County, New York, but his boyhood was spent in Iowa, where he received a common school education. At 22 years of age he organized a machine shop and foundry at Seattle, Wash., which has since developed into the Moran Iron Works. Next he became a Division Foreman on construction of the Mojave division of the Central Pacific R.R. Afterwards he was Master Mechanic and Superintendent of Motive Power of the Colorado Midland Ry. He joined the Westinghouse Air Brake Co. in 1903 as Western Manager, leaving the office of Superintendent of Motive Power of the Chicago & Alton R.R. He was made General Manager in 1915 and Vice-President in 1910.

OBITUARY

J. D. Allen, a civil engineer of Chicago, Ill., died Jan. 17 at Tuscola, Ill., where he had been assisting the County Surveyor on the Akaw drainage project.

Robert Sherrard Orr, Assoc. Am. Inst. E. E., Vice-President and General Manager of the Duquesne Light Co., Pittsburgh, Penn., died Jan. 28, aged 49 years. He was born in Clarion County, Pennsylvania, and educated at the public schools and at Washington and Jefferson College, where he was graduated in 1891. He was a school teacher in Allegheny until 1904, when he became General Contracting Agent of the Allegheny County Light Co. He was soon made General Superintendent and in 1914, General Manager.

Eugene L. Hurley, Assistant to the Valuation Engineer of the New York Central R.R. Lines East of Buffalo, died on Jan. 6, as the result of an operation. He was born in Rahway, N. J., Aug. 4, 1875. He was graduated from Rutgers College and entered the services of the New York Central & Hudson River R.R. in March, 1900, as Assistant Engineer, Maintenance-of-Way Department. In 1911 he had direct supervision of the forces engaged in the so-called Swain valuation of the Lines East of Buffalo, and in 1913 he joined the present valuation forces.

Frank Gilbert, a noted engineer of Montreal, Que., died on Jan. 23, in his 70th year. Early in life he became a member of the firm of E. E. Gilbert & Sons, engineers and contractors, known also as the Gilbert Blasting and Dredging Co. and the Canada Engine Works. On the death of his father he became the senior partner. This company was the first in Canada to introduce the chain tug for submarine drilling. It executed important and difficult pieces of engineering work in connection with the St. Lawrence canal system. Mr. Gilbert is survived by his widow, one son and one daughter.

Richard B. Dole, Chemist in Water Resources Branch of the United States Geological Survey, died Jan. 21, at his home in Washington, D. C. He was born in Portland, Maine, May 8, 1880, and was graduated from the Portland High School in 1898. In 1902 he received the degree of Bachelor of Arts, magna cum laude, from Bowdoin College, and in 1903 he took a graduate course in chemistry at the Massachusetts Institute of Technology. In June, 1903, he was appointed engineering aid in the United States Geological Survey; he was successively aid, assistant hydrographer, assistant engineer, assistant chemist, and chemist in the Water Resources Branch. He was a member of many societies and wrote many reports and papers on the quality of waters, including a chapter on water for industrial purposes in the "Manual of Industrial Chemistry" by Rogers & Aubert. A widow survives him.

John Fletcher Moffett died at a private hospital in New York City Jan. 28. He was taken ill with the grip early in the month and complications developing he was removed to the hospital on Jan. 16. He was born Apr. 15, 1841. He went to Watertown, N. Y., as a young man and entered the Watertown Bank and Loan Co., where he continued until 1882, when he associated himself with Frank A. Hinds and Henry C. Hodgkins, Civil Engineers, under the firm name of Hinds, Moffett & Co. In 1885 Mr. Hinds retired and the firm became Moffett, Hodgkins & Clarke. The firm engaged in the construction of railroads, water, gas and electric plants in all parts of this country and Canada. Mr. Moffett disposed of his last water, gas and electric properties about four years ago. Of his former partners H. C. Hodgkins, of Syracuse, N. Y., and C. T. Moffett, his son, of New York, survive. He is also survived by his son Earl M. Moffett, of Wilmington, Del., and three daughters.

ENGINEERING SOCIETIES

OREGON SOCIETY OF ENGINEERS.
Feb. 5. Annual meeting in Portland. Secy., Orrin E. Stanley, P. O. Box 973, Portland, Ore.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Feb. 5-9. Eighth National Good Roads Show, in Boston, Mass. Secy., E. L. Powers, 150 Nassau St., New York City.

NATIONAL LIME MANUFACTURERS' ASSOCIATION.
Feb. 6-7. Annual meeting in New York City. Secy., F. K. Irvine, 537 South Dearborn St., Chicago.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.
Feb. 7-9. Midwinter convention in New York City. Secy., F. J. Hutchinson, 33 West 39th St., New York City.

MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY.
Feb. 7-9. Annual meeting in Minneapolis. Secy., W. F. Rosenwald, Shubert Bldg., St. Paul.

TENTH CHICAGO CEMENT SHOW.
Feb. 7-15. In Chicago. Under management of Cement Products Exhibition Co., 210 South La Salle St., Chicago.

AMERICAN CONCRETE INSTITUTE.
Feb. 8-10. In Chicago at La Salle. Secy., H. D. Hynds, 30 Broad St., N. Y.

AMERICAN ASSOCIATION OF ENGINEERS.
Feb. 8-10. In Chicago at the Hotel La Salle.

NATIONAL BUILDERS' SUPPLY ASSOCIATION.
Feb. 12-13. In Chicago at Sherman. Secy., L. F. Desmond, 1211 Chamber of Commerce, Chicago.

ARKANSAS ENGINEERING SOCIETY.
Feb. 13-14. Annual meeting in Little Rock. Secy., Wm. J. Parkes, Pine Bluff, Ark.

INDIANA SANITARY AND WATER-SUPPLY ASSOCIATION.
Feb. 14-15. Annual meeting in Indianapolis. Secy., W. F. King, Indianapolis, Ind.

WISCONSIN ENGINEERING SOCIETY.
Feb. 15-16. At Madison, Wis. Secy., L. S. Smith, 939 University Ave., Madison, Wis.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 19-22. Meeting in New York City. Secy., Bradley Stoughton, 29 W. 39th St., New York City.

SOUTHWESTERN CONCRETE ASSOCIATION.
Feb. 19-24. Southwestern Concrete Show in Kansas City, Mo. Address Chas. A. Stevenson, 1413 W. 10th St., Kansas City.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS.
Feb 20-21. Annual meeting in New Haven in Mason Laboratory. Secy., J. F. Jackson, New Haven.

IOWA STATE DRAINAGE ASSOCIATION.
Feb. 20-21. Meeting in Fort Dodge. Secy., M. F. P. Costelloe, Ames.

IOWA ENGINEERING SOCIETY.
Feb. 21-23. Annual meeting in Ames. Secy., J. H. Dunlap, Iowa City.

The Louisiana Engineering Society, at the annual meeting on Jan. 13, elected the following officers: President, A. T. Dusenbury; vice-president, John Klorer; treasurer, Ole K. Olsen; secretary, W. T. Hogg.

The Western Paving Brick Manufacturers' Association, at the annual meeting Jan. 19 and 20 in Kansas City, elected the following officers: President, A. W. Shulthis; vice-president, H. J. Huiskamp; treasurer, Frans Janssen; secretary, G. W. Thurston, Kansas City, Mo. Several papers were presented and a lunch was given at the Baltimore Hotel.

The Nebraska Association of members of the American Society of Civil Engineers was organized on Jan. 5 at Lincoln, at which time the following officers were elected: President, Frank C. Darrow, engineer maintenance-of-way, Burlington R.R.; vice-presidents, Adna Dobson and George L. Campen; secretary, Homer V. Knouse, constructing engineer, Metropolitan Water District of Omaha, Omaha, Neb.

Albany Society of Civil Engineers.—The annual meeting and dinner was held on the evening of Jan. 23 at Keeler's Hotel, Albany, with over 100 members in attendance. Mr. Robert E. Horton was the Toastmaster. Among the after-dinner speakers was William R. Hill, former President of the Society, who gave an interesting résumé of the history of the Society and also of the early history of the American Society of Civil Engineers, which showed that for a long time in its early years the National society had little larger membership than the Albany society had at a similar age.

The Indiana Engineering Society at its recent annual meeting, reported in "Engineering News," Jan. 25, elected the following officers: President, C. F. Harding, Professor of Electrical Engineering, Purdue University; vice-president, W. H. Insley; secretary, Charles Brossmann, Indianapolis. Resolutions were passed favoring the preparation of a bill for licensing structural engineers, or having the architects' bill changed to include the engineers. Other resolutions favored preparing a bill to increase the compensation of county surveyors and to raise the requirements to five years' practical experience or three years in an engineering school and two years' practice.

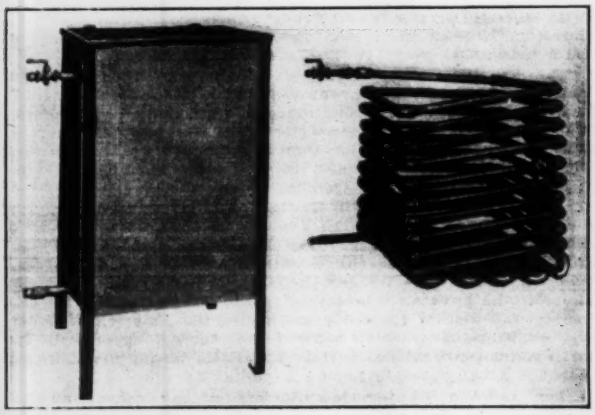
American Wood Preservers' Association—The thirteenth annual meeting was held in New York City, Jan. 23, 24 and 25. The report of the secretary-treasurer showed a net gain in membership during the year of 24. The total membership is now about 300. The report of the Committee on Terminology, giving definitions and descriptions of all the more common methods of timber preservation, was read and adopted. This report gives an excellent summary of timber-preservation methods. The Committee on Specifications for the Purchase and Preservation of Treatable Timber presented a 14-page report outlining: (a) Fundamental principles; (b) selection of treatable timber; (c) preparation of timber for treatment; (d) treatment of timber. This report contains a number of changes to be included in the association's "Manual." The report of the Committee on Promotion and Publicity advocated more individual activity and more general advertising of treated timber. The Committee on Service Tests of Ties and Structural Timber presented a valuable and systematic collection of data, of which a detailed analysis was presented by R. H. Hicks, Engineer of Forest Products, Forest Products

Laboratory, Madison, Wis. The report of the Committee on Plant Operation dealt with methods of measuring the quantity of preservatives used and of determining the volume in a charge of tiles, poles or piles, with plant records and ways and the means for reducing fuel consumption. Detailed methods of chemical analysis of different wood preservatives are given in the 65-page report of the Committee on Preservatives. This report was supplemented by a minority report of the subcommittee B on creosote and coal-tar oils, which took issue with the conclusions of the majority report on these preservatives. After much discussion the majority report was adopted. The reports of the Committees on Wood-Block Paving and the accompanying discussion are given elsewhere in this issue. Two papers illustrated by lantern slides were read, one on the "Grouping of Ties for Treatment" and the other on "Bad and Good Handling of Wood." The principal officers elected for the ensuing year are: President, John Foley, Forester, Pennsylvania R.R., Philadelphia, Penn.; Secretary-Treasurer, F. J. Angier, Superintendent of Timber-Treating Plants, Baltimore & Ohio R.R., Baltimore, Md. It was voted to hold the next annual meeting at Chicago, Ill.

Appliances and Materials

Water Heater for Concrete Work

The heater for water used in making concrete or mortar in winter, shown in the accompanying view, is a heavy steel salamander containing a triangular coil of 100 ft. of 1-in. pipe. The heater, which is 24 in. square and 4 ft. high over all, may be filled with soft coal, coke or wood, as may be most convenient. The coil is self-draining and has the lower end fitted for a hose connection, while the upper end is fitted with a cock. Both ends project through the side of the heater or



WATER HEATER FOR COLD-WEATHER CONCRETING

salamander. The device will deliver a steady stream of water at a temperature suitable for use in zero weather. The heater, which has been used by a number of contractors, is made by the C. A. Londelius & Sons Co., 847 West 63d St., Chicago.

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Concrete Roofing Tiles

The Walter concrete roofing tile is being introduced in Chicago, mainly for residences and small buildings, and also for industrial buildings. The tiles are 8x12 in., with corrugated surfaces that interlock, and have lugs by which they are hooked to strips spaced 12 in. c. to c. They are made by the Chicago Concrete Roofing Tile Co.

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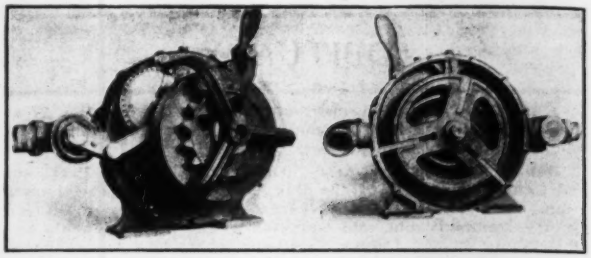
Water Regulator and Meter for Concrete Mixer

An automatic water regulator and meter to be attached to concrete mixers has been put on the market by the Anderson Meter Co., Providence Building, Duluth, Minn. It has been successfully used during the past season on work in that city. The device is in effect a centrifugal pump with metering attachment. It can, therefore, be used either as a pump, when motor driven, to fill tanks, sprinkle concrete, etc., or as a regulator of the supply to the mixer. It is operated by throwing the lever shown, the process thereafter being automatic. Desired amounts of water can be set on the gage and the regulator cuts off at the proper point. The device weighs about 75 lb., is 12-in. diameter and can gage automatically



AUTOMATIC WATER REGULATOR AND METER

from 1 to 20 gal. of water. In the accompanying figure, the left view shows guard and sprocket wheel on shaft, operating lever in upper right corner; inlet or suction, automatic valve and regulating dial on the left. The right view shows the reverse side, plate removed, disclosing interior.

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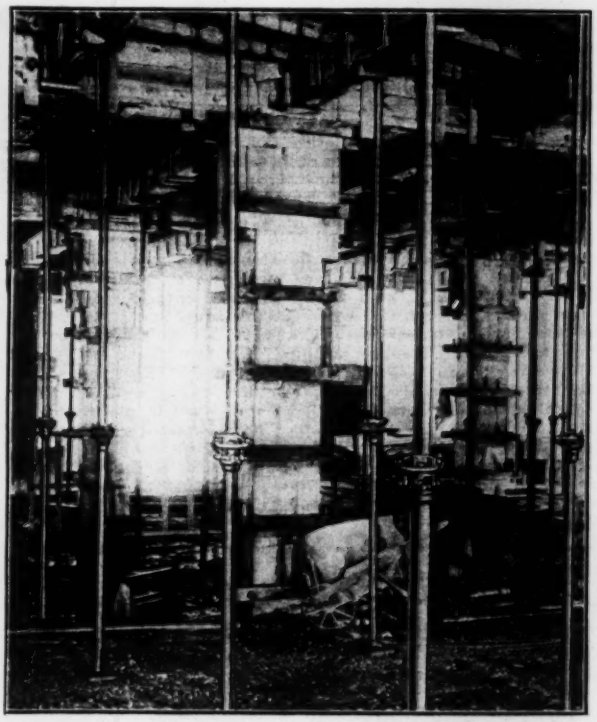
Steel Shores for Concrete Forms

The Gemco adjustable shore used for supporting formwork in concrete construction consists of two steel pipes telescoping each other. The 2-in. lower section is 4½ ft. long, with a broad base screwed to the bottom, while its top is fitted with a lever device for raising and adjusting the 1½-in. upper pipe and a gripping device for holding this pipe at any position. A releasing collar allows dropping the upper section of pipe about ½ in. to clear the load; this enables the locking dogs to be released and the pipe lowered into the larger pipe. The upper pipe is ordinarily 9 ft. long. Its top may be fitted with a flat head or with a forked head to receive a timber of the formwork. Special flaring or Y-heads may be fitted also to give ample bearing support under heavy beams.

To avoid the use of wood side-bracing for forms of heavy beams, where rigidity is an important feature, malleable-iron brackets can be attached to each end of this Y-head and a 2-in. vertical channel slipped through this. The channels are adjusted to the desired height and locked by dogs in the



TELESCOPIC STEEL SHORES SUPPORTING FORMS

brackets. They bear against the side of the form and have seats for a timber to carry the ends of the intermediate joints.

The accompanying view shows these steel telescopic shores in use in the construction of an eight-story warehouse of reinforced concrete in New York City. The shores and fittings are manufactured by the Gemco Manufacturing Co., Milwaukee, Wis.